CITRUS CULTURE *for* PROFIT

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FOR PROFIT

PRACTICAL DIRECTIONS

BY

Wilson & Toomer Fertilizer Co.

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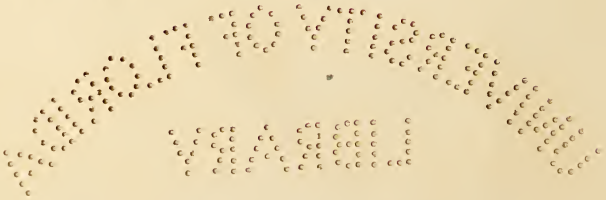
To Our Friends



Preface

In presenting this little volume to our readers we lay before them the methods of citrus culture that have proven to be practical and profitable. We are supplying the needs of those who wish to make citrus culture a business, and in so doing have eliminated the historical and botanical features, interesting to a student but of no value in making a grove a profitable investment. The methods we give in the following pages are not based upon the experience of one man merely, but are a compilation of the ways to success followed by leading growers in different parts of the State and cover experiences from the birth of the citrus industry. This information has been gathered and edited by competent people—growers who have not only had years of practical experience, but have carefully studied the scientific principles underlying all phases of the citrus industry—and we send it out with full faith in its ability to fulfill its mission.

Wilson & Toomer Fertilizer Co.

Jacksonville, Fla., Jan. 1, 1911.

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(By our Special Artist.)

Springtime in the grove of Col. S. P. Shepherd, Winter Park, Fla.

CHAPTER I.

Location

It is rather bewildering to the prospective citrus grower to find flourishing groves in such diverse situations and to hear from equally successful growers entirely different methods of culture. The citrus tree has certain needs, and when these needs are supplied it grows to perfection. When they are restricted it is quick to show the effect. This is the keynote to the equal success found in low hammock and all the varying soils to high pine land, and to the failures that are side by side with these successes all over the State. Where the soil is not underlaid with quicksand, or with hardpan coming within three feet of the surface, a grove can be made by using the proper means, but these means are so much more difficult and expensive in some instances than others, it is well to consider what is ahead of the grove-maker before one "puts his hand to the plow."

Many people err in striving to get "cheap land." A few dollars or a few hundred dollars really is not of much moment in comparison to obtaining the right location and right cultural conditions. If it is to be a family home, scenic beauty should be considered also, but we will dwell only upon the financial side of the matter. Fertilizer is heavy and the citrus crop is still heavier. One has to be hauled from the station to the grove and the other from the grove to the station, and various other things smaller than the above items but considerable in themselves have to be hauled also; therefore each quarter-mile added to the distance of location from the shipping point is going to be multiplied many times as the years go by and paid for most dearly in time and general wear on the team. It is cheaper to pay in the start to have the distance as short as possible. Another important item is good roads. If the good roads are already there one can well

afford to pay a premium; but if not, it certainly behooves the prospective settler to notice the chances of getting them in the near future.

Our choice of land would be a rich sandy loam with a clay subsoil from two to four feet below the surface, though there are many fine grapefruit groves on sandy lands underlaid with yellow soil. There is also much to be said in favor of the heavier lands down to the richest of hammocks. Other lands than these should be avoided, for the expense of making the grove will make too great inroads upon the returns to have the profits satisfactory. For instance, a sandy loam soil equally as good as our choice named above, but with a **sand** subsoil, will not hold moisture enough to sustain the trees, and as the moisture leaches away it will take with it a large percentage of the plant food. If the site can be on the south or southeast side of deep water it will be protected from cold to a great extent, but such fortunate locations are not easily found; however, one often can make sure of a good windbreak along the north and northwest of his proposed grove. The windbreak should be included in the purchase and not left open to the chance of someone cutting it away.

Drainage should also be given careful consideration. There can be no success without proper drainage, either natural or artificial, and land naturally drained or easily drained is worth far more than that needing an extensive drainage system. Drainage is an expensive item in most hammock groves, but the constant moisture is a great advantage. The young trees are likely to start off better and after the first expense of clearing and ditching, the grove, if handled right, generally takes less from its owner's pocketbook for the results it gives. One of the best groves in the State, which also produces the fanciest of fruit, is in a hammock so low ditches are cut between each row of trees and the water table is only two feet below the crown roots. Needless to say this is an extreme situation and one that only an

expert could handle with success. He cultivates just enough but not too much, and when the land is in exactly the right condition so that it is aerated and not "puddled" or soured, and fertilizes so judiciously as to overcome all the rank coarseness natural to fruit grown on such rich land. No one could give the prospective grower directions how to do this—he would need to watch conditions and act at exactly the right time. As soil is lighter and less wet the time and manner of cultivation is of less importance, hence our choice of a sandy loam, for there are few of us so especially gifted in judging soil conditions. We can more easily learn to add humus to our land and to cultivate in a way to conserve moisture than to judge to a nicety the exact needs of a low hammock; but these points will be taken up more in detail under Culture, Chapter V.

The Site of a Future Pineland Grove.

CHAPTER II.

Preparation of Land

There is one fine grove where the owner set his trees in cleared spots and finished clearing the land "while the trees were growing." We wish we could have watched the clearing with the endeavor to learn the "saving circumstances" in this particular case, for others trying this way have invariably failed. All new comers will do well to shun such get-rich-quick plans.

Properly preparing land is quite an expense, but it is far better to set from one to five acres and have the trees started right than to spread the same investment over five to twenty-five acres and make a failure. It is impossible to tell the cost of preparing land, but it is safe to reckon on from fifty to seventy-five dollars per acre for strong pine land to twice that for rich hammock. This will generally include ditches and fences.

It does not pay to select sparsely covered land to save expense in clearing, for that which has not produced native growth can not be expected to produce cultivated crops. Especially avoid places where only grass grows. The lack of trees and saw palmetto shows the land is at least saturated, if not actually covered, with water during several months of the year. We mention this because we have seen so many houses erected in such open places by people coming to the place in dry seasons. Such "savannas," as they are called, will be found running through many tracts of land, but they should not be accounted as building sites or citrus land.

In clearing land it is far better to contract for a certain price per acre with an experienced person than to have it done by day labor. There is a great deal in knowing how to get at the work in the right way, and while the contractor may make a good profit on the job, it will undoubtedly cost far more to employ unskilled workmen. It is generally best to remove in

one way or another all the roots and bushes taken out, as well as the trees, though some pile in windrows, where it takes years for them to decay, and all that time they make an unsightly, inconvenient mass. On damp, heavy land the rubbish can be burned, but on dry, loamy soil such fires will burn the humus in the land and do a great deal of damage. In disposing of trees one is most fortunate if he can sell the trunks to a sawmill and work the larger limbs into stove wood, using the tops to burn out the stumps, but few find this ideal condition. The trees should be removed in some way, though, for however strenuous a job it is at the time of clearing, it will be far more complicated when the citrus trees are set and have to be considered in all one's movements. Each locality has generally found a satisfactory way to dispose of the native growth, and one can be guided accordingly.

Ditching is the next proposition. Even the best naturally drained land is better off to be surrounded by a "root" ditch which prevents the wild growth from sending roots into the cultivated land. The mellow soil and bountiful supply of plant food have great attractions, and the distance these wild roots will run is incredible to those who have not seen them. The root ditch also prevents the water seeping from the wild land into the grove. This water carries tannic acid and other deleterious matters and often does noticeable damage in rainy seasons, while at all times it is an unseen power working against desirable conditions.

People are altogether too ready to believe Nature has provided sufficient drainage. On this point it is far better to be a pessimist than an optimist. When for any length of time water fills the spaces between the soil particles, driving out the air necessary to nitrifying bacteria, these bacteria die and it takes months for them to become reestablished. By that time another rainy spell comes on and the circle is gone over again, so the

land that needs draining a small part of the year is practically very little better than that which needs it the greater part; but it will take a less extensive drainage system to relieve it. Experience has taught us that underground drainage is not a success in citrus groves, because the roots will soon work their way in and choke the passage ways. Open ditches should be used and the way they are arranged depends entirely upon the lay of the land. Each place must be ditched according to its needs. When plowing such land the last time before setting the trees, it is best to lay it off in beds, leaving a water furrow between each row of trees.

Barbed wire seems to be the standard fencing, having won its place by the service it gives for the money invested. It should be put up so that the wires are taut and the effect pleasing. It is well to do this clearing, ditching and fencing during the winter, and at spring-time plow and spread broadcast one ton per acre of lime or twice that of finely ground limestone rock. The light, dry lands need less lime than heavy, wet lands. Harrow and cross-harrow until the ground is in good tilth and sow about a bushel of cowpeas to the acre. The lime will sweeten the soil and hasten the disintegration of the broken roots left in the ground, while the cowpeas shade the ground over summer and keep the summer rains from leaching it and also in their growth remove some factors from the new land which are unfavorable to citrus growth and add nitrogen to the soil. In the fall they should be mowed and, when dry, chopped into the land with a cut-a-way harrow, making a valuable addition of humus which is beneficial to all our Florida land.

CHAPTER III.

Varieties

Many representatives of the citrus family can be grown in Florida—kumquats, the several groups of oranges, pomelos, shaddocks, citrons, limes and lemons—but generally the investor has learned to confine his operations to the orange and "grapefruit," as the pomelo is popularly called. There are, of course, some exceptions.

For our readers' information, we will dwell more fully upon the different kinds and varieties than a strictly financial viewpoint would warrant, because often one wishes to have a few trees for pleasure rather than profit.

Kumquat.—The kumquat is a strictly fancy product, used more for its decorative qualities than for consumption, though many are fond of the fruit both fresh and preserved. The rind is not removed, for its spicy flavor combines happily with the acid juice. For decoration, twigs are cut carrying several of the richly colored fruit nestling among glossy, dark green leaves. The kumquat grows on a shrub rather than a tree, as it seldom reaches a height of more than ten or fifteen feet and is generally fully as wide as it is high and a mass of foliage. The two leading varieties are the oblong and round, but the former is greatly to be preferred. The kumquat is quite hardy, especially when grown on trifoliate stock, and flourishes with a little protection in the extreme northern part of the State.

Shaddock.—The shaddock is raised only as a curiosity because its fruit is so large, weighing sometimes as much as fifteen or twenty pounds. One variety has a pink pulp. The shaddock is often confounded with the grapefruit because they are of the same species botanically, but to the consumer there is a vast difference with all points in favor of the grapefruit.

Citron.—The citron, which is of value only for its thick

rind, from which can be made a product equal to the candied citron of commerce, will flourish in the extreme south and on the islands, but though this industry never has received much attention, even the little interest that has been shown it has died out and it is only occasionally one sees a tree left, and then rather on sufferance than because its owner cares for it. The best variety is called the Lemon Citron. The fruit weighs from three to eight pounds.

Lime.—The lime is our most sensitive member of the citrus family. It has become naturalized in the southern part of the State and the islands, and grows well under most adverse conditions. For some reason, though it is a most popular fruit, it has not proven a remunerative one generally to the grower who has tried to cultivate it for profit. Whether this is a fault in the shipping or otherwise we are not prepared to say. Every settler should have two or three lime bushes for his home use, protecting them during cold spells when situated far enough north to need such protection. The common small Mexican lime is by far the most satisfactory. Individual specimens of the Rangpur and the Tahiti are larger and seem superior at first, but one soon longs for the good old-fashioned lime. The Rangpur is of medium size and seems to be of the Mandarin family. Its abundant juice is a clear, strong acid, very pleasant to the taste, but not at all like a lime. Indeed, it is rather a mystery why this fruit is classed with limes. The Tahiti is a real lime of large size and very juicy and seedless. In Florida it is inclined to decay on the trees by the time it reaches maturity.

Lemon.—At one time the lemon industry in Florida was quite important, but it has dwindled to insignificant proportions. The lemon is too tender to be a sound financial proposition except in the extreme southern part of the State, and people have turned their investments into other channels. However,

every home should have a tree or two. For this purpose the Everbearing is a favorite because of its constant fruitage, but the rind is altogether too rough and the seeds too plentiful to make it an article of commerce. The Villa Franca is also used. The tree is practically thornless and is prolific, while the fruit is most desirable in appearance as well as in quality. This variety has predominated in Florida plantings.

Hybrids.—There are also several hybrids of more or less value that make a pleasant addition to one's home supply of fruit, but such trees are not on the market, and many of them have not been thoroughly tested, so we will not try to describe them here.

Oranges.—Years ago, when one was about to set an orange grove, he was confronted with a score or more varieties all clamoring for first and greatest attention. Those varieties have been dropped one by one, as they were found to be lacking in some essential point until the would-be grower of today finds only a few claimants for a place in a financial investment and perhaps a half dozen non-profitable favorites because of some special quality. We will quote from two equally good authorities, both having had wide experience throughout the State for the past thirty years. One has looked more to the orange grove that is also a home and the other has more thoroughly experienced the setting of great groves as a financial investment.

The first says: "A very satisfactory proportion has been found by planting one-third of the grove to grapefruit, about one half to oranges divided into early, medium and late varieties, and the remainder to Dancy's Tangerines. For the grapefruit the Duncan and the Indian River are good varieties, the former ripening the earlier, while Parson Brown, Pineapple and Valencia oranges furnish fruit at three different seasons. There are many other varieties, but as we can not give space to all we simply name some of the best known."

The second tells us: "In planting a grove these days, when fruit is being handled in carload lots more than in any other way, it would be the part of wisdom to select one good variety that is proving highly successful in the community, and let the entire grove be planted to that one variety.

"Among the diversified lands of Florida we have here one piece that is particularly suited to grapefruit, and there we have another piece that is admirably suited to the production of early oranges, such as Parson Brown, etc. On still another place we have a piece of land containing a high percentage of iron and lime and well adapted to the production of highly colored and perfect specimens of the Pineapple orange. On other soils we have the moisture preserving and attracting nature that enables to grow and to hold over in perfect condition the Valencia Late or Hart's Late; and our varietal selection should be made with due consideration of all these points; and if the land is suitable for any one class of fruit, like those described above, do not diversify on any particular ten-acre tract."

The Parson Brown is medium to large in size, yellow in color, sometimes with orange tinge, rind smooth and bright. Its season is about October and November, and if it is not gathered when matured soon loses its flavor.

The Pineapple is more or less oblate in shape, size medium to large, has deep rich orange color, often with reddish tinge, rind most attractive, being very bright, smooth and glossy. The juice is abundant and of exceptionally good flavor. Its season is about January or February, but it can be held later. Really, at the present time, this is the favorite orange because of its many good qualities, and the new orange groves set by old growers show a very large percentage of this variety.

The Valencia Late and Hart's Late are so near alike their best friends make little or no distinction between them. They are round or slightly oval in form, medium and large size, deep

golden orange in color with thin, smooth, tough rind. They have abundant juice of rich flavor, and such a combination of acidity and sweetness as to be especially pleasing during the spring months—March to June—when they are in season.

The oranges of the Mandarin family are so attractive in appearance and the neatness with which they can be handled that the effort to make them profitable has been a strenuous one. They are distinctly a fancy product, and any lack in appearance or quality practically bars them from the market, for the epicure does not want them at all and the ordinary consumer only at extremely low prices. The grower must find a generous market to make a profit, for the fruit is small, and therefore it takes a great many to a box and much work to wrap and pack them. If, however, the fruit is of the right quality and is put up in strictly fancy packages it will bring him pleasing returns. Of the several varieties included in this family, the Dancy Tangerine is the only one which, when grown under Florida conditions, seems to develop sufficient fruit of the right quality to make it profitable. It is oblate in form, medium size, deep orange red, smooth, shiny rind which is easily removed, sections separate easily, flesh dark orange in color, coarse grained, abundant juice, scarcely any rag, flavor rich; season, December and January.

Of the special favorites we will mention but three. The King is of the Mandarin family. Is most unattractive in appearance, but of delicious flavor. Wood is very brittle and branches break when well loaded with fruit. The Ruby blood orange has a delicious flavor and is interesting because its flesh is first yellow, then streaked with red and finally becomes blood-red when fully ripe. The fruit is of small size and the tree very susceptible to attacks of diseases. The Washington Navel is also a novelty because of the secondary orange in the blossom end giving it the navel-like appearance, and is delicious to the

taste. It is a great commercial success in California, but has proven a very shy bearer in Florida.

It is from the oranges described above that the orange grower now makes his choice. He plants for early, medium or late shipment as suits him personally, or the location he has selected, and if he decides to cater to the tangerine epicure's taste, he plants the Dancy. He no longer weighs and re-weighs the respective merits of a dozen different varieties of each class.

Grapefruit.—But the grove-maker of today is likely to be more interested in grapefruit than oranges. The increasing demand for this product is incredible, and the hundreds of acres that have come into bearing the past two or three years seem to have no effect upon the high prices prevailing. Many are making a large portion or even all their new plantings of grapefruit rather than oranges. In such case they generally select the Duncan as the most satisfactory variety. It is oblate in form, of medium size, attractive appearance and fine flavor. It bears freely, but not in such close clusters as to mar the fruit, and is desirable in every way.

To those who have a favorite variety not mentioned in the above list, we would say, we in no way class all unmentioned fruit as worthless. This book is not intended to include full data on the subject; we are simply pointing out to the would-be investor the kinds that have given the best results generally, and we are sure none can deny that position to the ones we have named whatever special successes he may have known.

CHAPTER IV.

Planting the Trees

In the "good old days" the greater number of groves were started from the seed. Sweet seedlings were numerous, and where other stock was used it generally was raised in some obscure corner and grafted, or more often budded, with wood from some favorite tree either growing on the home place or owned by a neighbor. Failures of the buds to take were many at first, but the knack of budding was soon gained, for it was necessary knowledge at that time. There were no well-established nurseries, and in the rare instances where budded stock could be bought one could not feel sure he was getting desirable trees, and it was too great a risk to run.

These conditions are so completely changed that we feel justified in omitting the chapter on propagation that appears in all citrus publications. The grove-maker of today has no thought of this preliminary work; he is in haste to see his trees fruiting and finds budded stock at hand offered by nurserymen upon whom he can depend to give him buds true to name and free from disease and insects—trees that are neither forced nor stunted, strictly first class nursery stock. That is, he can get such trees by paying their market value. There are always trees that are "off quality," old and stunted, weaklings, ill-shaped specimens, etc., that can be bought "cheap," but he who buys them pays dearly for his bargain before they come to bearing.

The sour orange has proven so superior to all other stock that it is now almost universally used throughout the orange-growing sections. It is far more resistant to both cold and diseases than the sweet orange or rough lemon, and gives greater thriftiness and health to the tree. Both sweet and lemon stocks are likely to succumb to foot-rot, while the lemon stands little cold. In the northern part of the State the trifoliate stock is used

to a great extent because of its hardiness, but its most earnest advocates in that section would not advise it for milder situations. There is a difference in opinion as to the best age of tree to set. To the investor who has plenty of capital it is a great temptation to pay the higher price and get a nice big tree with two-year-old bud, but it has been the experience of the greater number that a two or three-year-old stock and one-year-old bud stands transplanting better than the older tree, and when put side by side will be larger and thriftier two years after setting.

It is well to engage the trees early in the season so as to make sure of getting the pick of the stock rather than the leftovers, but they should not be shipped until the land is in perfect readiness so as to get them in the ground as quickly as possible. The best time to set trees is from the middle of November to the middle of February, though, with proper handling, it is safe to move an orange tree at almost any time.

If the land is not perfectly drained naturally it is well to plow it in beds twenty-five or thirty feet wide. Harrow the beds smooth but leave a deep furrow between them to carry off the excess of water. Very low lands can be utilized for orange groves if they are properly ditched and bedded up.

Stake off the places for the trees. There is a wide range of opinion as to how far apart trees should be planted. It is essential that the roots have plenty of room in the ground and the branches plenty of sunlight if the trees are to be in the healthiest condition.

These points are too often overlooked. The trees must have moisture, and under ordinary conditions the soil does not hold enough to sustain a crowded grove. To understand the value of sunlight, let us briefly note the course of the plant food after it enters the plant. It is absorbed through the cell walls and passes from cell to cell upward, remaining the same crude sap, incapable of nourishing the plant until it reaches the leaves. There

it is "digested" and becomes "elaborated" sap capable of forming live substance, first in the vegetable kingdom and then on to animal matter. This change can take place only in those portions of the plant which are green in color, being the result of the combined action of chlorophyll and sunlight. Chlorophyll is the green substance in leaves, young twigs and immature fruit, and while absolutely necessary to higher plant life, is powerless to act except under the influence of the sun. All growers appreciate the value of color in the leaf, but many fail to realize the great importance of abundant foliage and of giving sunlight free access to same. Dense growth encourages disease as well as insects. From the leaves, the elaborated sap goes by way of the inner bark to supply the various needs of the plant, but if sunlight has been lacking the supply of elaborated sap is bound to be limited.

Trees may do well, but they can not do their best unless they have sufficient room. We prefer to have the trees twenty feet apart, in rows thirty feet wide. This gives them about the same space as though set in a twenty-five foot square, and the thirty-foot row makes a good passage way for a team when the trees are grown, while a narrower space would be nearly closed. It is wise to look ahead about such matters. In regard to the idea advanced by some people—that of setting the trees very close and removing half of them to other ground when they begin to crowd—we can only say that this has not been worked out. It looks very attractive on paper; one almost feels he is making two acres of grove for the cost of one, but since the fertilizer has to be applied so much per tree, not acre, the only saving would be in working the land and the use of the money used in clearing half the land five years before it was necessary, according to this theory. We agree with the large number who feel the plan to be utterly impracticable. It is doubtful about such trees surviving the transplanting because it would be very difficult to secure all the conditions necessary for such results,

and, besides, we fear since the root systems would be intermingled that the damage to the roots of the trees left standing would be severely felt. This being a book of facts, not theories, we should not mention the above did we not feel it might appeal to many and that a trial of the plan would result in severe loss.

There are "many men of many minds" on the above questions and each inexperienced person must decide for himself as to which road that has been paved to Success he will take, or if he will try a trail that either himself or someone else thinks will lead to Success, though it never has been traveled.

In taking up the trees in the nursery the tops should be cut off about one and one-half or two feet above the ground and the roots should be cut to about a foot in length with the tap root one and one-half feet. This preserves the balance between root and top. Do not make the mistake of trying to keep too much top. The trees must be kept damp from the taking up until they are set in the ground. Most of the trees that are lost get their death stroke between the digging and the setting.

Pull the dirt from around the stake with a hoe, leaving the ground in the shape of an inverted saucer, the bottom edge being about a foot deep. Drive the stake into the ground to make a hole for the tap root. Place the tree in the hole and spread the roots evenly. Let the trees be an inch higher than they were in the nursery, for they will settle some. Pull a part of the dirt over the roots and pour on a bucket of water. Pull more dirt around the tree and pack tightly, mounding up a little in the shape of a saucer and pour on another bucket of water, and then mulch to prevent evaporation. There should be no delay in the work from the time the dirt is first disturbed until the mulching is in place, thus preserving the natural moisture of the soil.

The trees will need no further attention for several weeks unless the season is especially dry, in which case water should be given very sparingly until the rain comes. Too much water will cause the soil to sour and give the trees a serious set-back.

About the first of February give each tree a pound of our **W. & T.'s Special Mixture No. 1** or **Seminole Tree Grower** or **Peruvian Orange Tree Grower,** spreading it in a circle around, but not too close to the tree, and hoeing or raking it in. A little later plant cowpeas in the middles to be used as described in Chapter II.

It is a mistake to try to "garden" in a young grove. Give the land over to the interest of your trees entirely if you would have them prosper, and if you wish to garden, take other land. It will pay you in the end.

As the young trees commence to grow, keep off all sprouts below the bud and leave all above the bud unless they seem especially crowded, when it will be best to pinch off the top of some of the shoots. Generally speaking, the tree needs all the foliage it makes and knows much better how to grow a suitable top than does the grower who tries to train it.

Keep the trees well worked, but never stir the ground when saturated with water or turn under any green vegetation, for it will sour the land and cause die-back and other diseases.

Since working many lands during the heat of the summer creates acidity, the mulching around young trees should be very heavy to prevent the growth of grass. It also should cover quite a large circle that the roots may have plenty of room to spread in the shaded ground that is free from grass and weeds. Particular attention should be paid to the wide spreading of the roots, for the more surface they cover the better they can support the trees. In applying the fertilizer the quantity depends upon the size and condition of the tree, but a newly-set tree will likely need a pound of **Seminole Tree Grower** or **Peruvian Orange Tree Grower** for the first summer application, which should be made about June 1st. It always is well to spread it in a circle commencing not too close to the trunk and extending a little beyond the outermost branches.

CHAPTER V.

Culture

Now we have our grove fairly started and are face to face with the problem of cultivation. In our first chapter we spoke of a tree having certain needs. Cultivation is in a great measure the means by which we are to supply those needs, so to understand the matter thoroughly let us give brief attention to general conditions underground, for successful cultivation is not a mere stirring of the soil, but it is the bringing of Nature's forces to work for our benefit.

Our first need is to examine the tree, after which we can better understand its relation to the soil. One of our workers read a paper on plant life before the State Horticultural Society, at Orlando, May, 1910, which was so heartily received by the leading scientists and horticulturists of the State that we feel we can do no better than to quote from it in this instance, and also in the chapter on fertilizers in regard to the effect of different materials:

"Whether tree or vegetable, the process of growing is practically the same. There are three distinct parts—the roots, the stem and the foliage. Different vegetations have different root systems, but all are alike in that there is no real opening into the roots, therefore all nourishment must be taken in liquid form; also in that it is only near the tips of the rootlets that the absorption of fluids—osmosis, it is called—can take place.

"The extreme tip of a rootlet is protected by a hard cap, that it may push its way through the soil, while its 'feeding' section is often covered with hair-like protuberances, multiplying the surface many times. These tiny rootlets also give off certain acids which render soluble much plant food that can not be dissolved by water alone.

"It is a root's nature to avoid light and to seek moisture. It

will go in the line of the least resistance, growing around obstructions, and wherever a good feeding ground is found rootlets are formed rapidly, giving full service to the plant which they support. If, however, the environment is not congenial, rootlets wither and die, and the plant receives no nourishment from that portion of its root system. Roots demand a proper supply of both air and water. To supply this demand the grower must cultivate his soil properly. Lumpy soil is bad for several reasons. The hard lumps act as obstructions, wasting the energy of the roots as they grow around them and check capillary action by the large spaces between them. The excess of air in these spaces rapidly dries out any moisture that the rains may give such soil, so that often the rootlets die in the attempt to encompass such obstructions. Plants must have water, not only for itself, but as a vehicle of food. The ability to hold moisture decides to a great degree the productiveness of a soil. Fine particles of soil not only increase capillary action by which underground water is brought to the plant's service, but they present much greater surface to retain the rain water and to be acted upon by dissolvent forces. We all know how much more readily a lump of sugar dissolves when crushed, and in the same way all other things yield to dissolution according to the surface exposed to attack. Soil should hold water in a film around each particle —as seen on an orange that has just been dipped in water—and this is all it will retain when there is a chance for the water to pass off. If there is a lack of drainage so water fills the spaces between these particles, there is no room for air, and therefore the supply of oxygen necessary to the bacteria of the soil is shut off and trouble begins.

"We must not look upon the earth as an inert mass. A fertile soil is alive with bacteria. Bacteria are the lowest form of vegetable life—tiny one-celled plants—but their influence for good or ill is incalculable. We, who are working the soil, are

more especially interested in nitrifying bacteria which are essential to the changing of nitrogen to nitric acid, or in other words, making the element, nitrogen, available for plant food. This bacteria can thrive only where there are the right degrees of moisture and heat, and freedom from acid conditions; hence, another great value in perfect tilth and proper drainage. On the other hand, where excessive moisture and acidity exist, the denitrifying bacteria thrive. These tiny plants take oxygen from seemingly every combination found, but their work is especially noticeable where, by the breaking up of these combinations, it sets the element nitrogen free and thus allows it to escape from the soil. Thus poor tilth and drainage not only prevent an increase of fertility but cause actual loss of the most valuable plant food the soil contains.

"We have dwelt in particular upon the desirability of having fine soil particles, but it is possible to have soil too fine to give best results. This is sometimes the case in clay lands and is particularly true in "puddled" soil, for "puddling" the soil is done by disturbing it when there is so much water present as to allow the soil grains to move freely about and become placed in the most compact position. This prevents proper circulation of air and often causes so much trouble from the effects on bacterial conditions and the general texture of the soil that it will take two or three years to overcome the results of a few hours ill-advised cultivation.

"There has been so much agitation about the necessity of supplying humus to the land that every grower recognizes the value of humus, though often he is rather bewildered as to the reasons therefor. Humus is plant food to be sure, but that is its least value. It retains moisture and with it the plant food this moisture contains. It is said that a soil well-filled with humus will hold eight times as much water as one entirely lacking this valuable constituent. Humus is a most congenial dwelling place

and also a food for nitrifying bacteria, therefore, causes great multiplication of these useful organisms. Humus also does much good by improving the texture of the soil. When the land is sandy and too open, the finer particles of humus help to correct that condition; and the humus is coarser than the soil particles of clay, so it opens up such land to freer circulation of air and all the accompanying benefits. One can hardly over-estimate the value of humus, but still he must realize that its greatest value comes through its retention of plant-food-ladened soil water, which otherwise would carry its precious burden onward to the drains.

"When the vegetation which produces this humus is grown on the ground over summer the fresh green blanket protects the soil from the excessive heat of the sun and thereby removes a great factor in the creation of acid conditions. However, the grower should never turn under this green vegetation or its fermentation will cause it to be a source of great harm instead of benefit. It should be dead and dry before being incorporated with the soil.

"Land should be thoroughly prepared before planting any kind of crop, whether it be grove or garden, and thereafter worked with due care for the roots. It is not consistent to strive to create a root system to feed trees or plants and then deliberately impair that system to such an extent as to reduce its strength from 25 to 50 per cent; yet that is what many a grower does time and again. During proper seasons land should be given shallow cultivation to conserve moisture by creating a dust mulch and to avoid a crusting over which shuts off the circulation of air, but this cultivation should never disturb the plant's roots."

Thus, we find the whole secret in good cultivation is to supply a proper amount of air and water and congenial bacterial conditions. It sounds simple enough, but to accomplish it re-

quires rare judgment. If the worker could see the damage he so often does when he is striving to benefit his trees, it would be a revelation. The general principles are all included in the above quotation, and each one must take such means as are necessary to bring about the right conditions on his land.

Some land needs shallow plowing, some deeper, though the roots never should be torn. Other land needs no plowing at all. The cut-a-way harrow is the right implement to use in many groves, while still others are better off never to disturb the ground outside a wide circle around each tree, which should be hoed three times a year and covered with heavy mulch. The natural grass is allowed to grow, being cut from time to time with a mowing machine and left on the ground. These groves are on damp ground, and often despite good ditches would be too wet through the rainy season were it not for the great amount of moisture used by this heavy growth of grass. Some people have said they did not want to fertilize grass and weeds, that fertilizing the trees was all they could afford. So long as no growth is removed from the land they get full benefit of all fertilizer applied, for the plant food lost in the energy of growing the grass is more than balanced by that saved from leaching away in the drainage and gathered rrom the air by the growing plants. On lands only fairly well watered clean cultivation through the spring months is almost imperative for the purpose of conserving moisture. One can by this method make a difference in the water content equal to several inches of rainfall. He also can cultivate so as to increase the evaporation and make the land drier than ever. To conserve moisture the ground should be stirred only on the surface and left as smooth as possible. This should be done every few days and is especially necessary soon after a rain. Often in the case of a light shower the surface is barely moistened enough to touch the moisture below, and far more water will evaporate through this

connection than has fallen unless prompt action is taken. On dry, sandy lands it is better to plant cowpeas or a similar cover crop over summer, for the native growth is not likely to be heavy enough and of the right kind to give the best results. Such lands can be made quite fertile in a few years by careful attention to the humus content, while lands that are too close and heavy to give the best results can be made more open and friable in the same way.

We are now ready to close this chapter, but it is not complete without mention of the "clean culture" method. All we can say about this is that in a few—a **very** few—of the best groves in the State we find clean culture. This fact can not be disputed, but the land was very rich at first and has had immense quantities of fertilizer applied; still, Nature's provision does not last indefinitely, and chemicals can not fill the place of humus, so each year sees fewer "clean culture" groves. One may as well hope to draw money from the bank continually without making deposits as to hope to remove crops of any kind year after year without making a return of the most important constituent of the soil.

CHAPTER VI.

Fertilizer

"The plant needs in its construction about fourteen different elements, but Nature makes a bountiful provision for all except nitrogen, phosphorus, potash, and sometimes calcium, so we need to study only these which we have occasion to supply. **Chemistry** teaches us that plant food is plant food wherever found, but **practical experience** teaches us that the form and surroundings of that plant food have great influence on its effect.

"In all animal substances as well as in vegetable matter, the breaking down of existing combinations which we call decay creates more or less acidity according to the condition and surroundings of these substances. If there is an abundant supply of air, enough but not too much moisture, and the temperature is neither too high nor too low, nitrates are formed from the nitrogen and the humus contained in the vegetable or animal matter is a valuable addition to the land. So, under right conditions, organic sources of plant food, though the slowest of all ammoniates, are desirable except for the citrus family. But if the weather be cold or the soil lacking in moisture, the decay is so slow as to be scarcely perceptible, while if there is an excess of water, humic and other deleterious acids are formed in place of nitrates, and instead of plant **food** we have plant **poison.** This latter condition readily arises under the combined influences of the summer's heat and heavy rains.

"We have noted the needed presence of certain bacteria to transform the element nitrogen to plant food. Their work is to combine oxygen with nitrogen to make nitric acid. After they have done this, it is most important that there be at hand a bountiful supply of base to unite with this nitric acid and form nitrates, and to neutralize not only the nitric acid but all other acids. If base is lacking it must be supplied before good results

(By our Special Artist.)

Mr. J. W. Perkins of Oakland has raised his grapefruit trees strictly by Ideal methods. The above view shows the result given in four and a half years. Energy combined with an intelligent following of our directions brings success.

can be obtained, and it is at such times that we need a knowledge of the different forms of calcium. The form generally preferred is the carbonate of lime found in ashes and air-slaked lime, but the hydrated, the "quick" or caustic lime, and also the finely powdered limestone have their places.

"The chemical nitrates are the quickest acting sources of ammonia that we can apply, as they are ready for the plant's use as soon as dissolved and so deliquescent that they invariably find enough moisture to dissolve them, therefore they are most valuable to start a quick growth, especially in a dry season. The great drawback to their use for a full supply of nitrogen is the waste that is bound to occur when rains come before the plant has used it all. Nitrate of soda and nitrate of potash are our general sources of this form of plant food at the present time, though calcium nitrate is knocking at the door of the fertilizer market. The nitrate in each of these materials is in exactly the same form. The soda in one and the lime in another tending to sweeten the soil, while the potash in the nitrate of potash is the straight K_2O plant food.

Another chemical used is sulphate of ammonia which in its action is slower than the nitrates but quicker than organic matter, even when favorable conditions surround the latter. It also is surer in its action and free from the disagreeable features attending the change of organic nitrogen to ammonia. The continued use of this chemical will call for an application of lime, as its chemical reactions in the soil cause loss of lime, but this is a small drawback in comparison with its incalculable value, especially to the citrus grower.

"Much attention has been given to the effects these varying sources have upon plant life. Generally speaking, the citrus tree demands chemical sources, the pineapple, organic sources, while the garden products need the different sources in well-balanced proportions. These sources are all classed as ammoniates.

"Now we come to the essential termed 'phosphoric acid'—another misnomer—for there is no real **acid** in any properly prepared fertilizer. All chemical fertilizers are in the form of salts. A **salt,** as explained in last year's paper, is the result of an acid being **destroyed** by a base displacing the hydrogen. In nitrate of soda, sodium has driven out the hydrogen, while in nitrate of potash, hydrogen has been exchanged for potash. In the first, the plant extracts the nitrogen from the **radicle** of the acid, while in the last it takes food from both radicle and base. In sulphate of ammonia, it is the base we think about as furnishing plant food after the necessary nitrifying process, though both sulphur and oxygen are essential to the plant's development. In the sulphates of potash it is also the base that is bought for food. The ammonia in sulphate of ammonia and the potash in the sulphates of potash are combined with the **radicle** of sulphuric acid—exactly the same part of sulphuric acid that exists in sulphate of lime and every other sulphate—just the sulphur and oxygen. These elements are absolutely harmless unless combined with hydrogen in certain proportions to form an acid. There is no possibility of reaction taking place, for the hydrogen has been defeated in a fair fight. The base has stronger attractions or it could not have displaced it. It is on this principle of a fair fight and no favor that our phosphoric acid is made available for use. The radicle of phosphoric acid is the form from which the plant gets its phosphorus, but in the natural state this radicle is in such close combination with lime that neither water nor the exudations from the plant roots can do much in the way of breaking the chemical forces; but, fortunately for the grower, the chemist's skill can overcome this difficulty and we have either dissolved bone or acid phosphate to apply to our fields, knowing that in both ingredients we have a mono-calcium phosphate and a sulphate of lime. The same form of plant food is in each, but it is accompanied by a little more sulphate of lime in the

acid phosphate than in the dissolved bone. This sulphate of lime is really no plant food, but it has a wonderful influence on the crops because of the chemical changes caused by its presence in the soil, through which much latent plant food becomes available. Such an agent is termed a 'catalyzer,' and it is now generally recognized that phosphoric acid is also a great catalyzer, and that it well pays to apply far more than is actually needed by the plant, because of this quality. Another effect of a large phosphoric acid content is a tendency to hasten maturity. This is a detriment in the raising of some crops, beans and celery, for instance, but the citrus grower who wishes to avail himself of the advantages of an early market finds this fact of great value.

"Basic slag is another source of phosphoric acid. It is very slow acting and its value is still undetermined.

"Peruvian guano is called a phosphatic fertilizer, but contains some of all four essentials. Though of organic origin, it cannot be classed as an organic fertilizer, really, for its condition is such that although it has all the virtue of organic matter it has none of the evils, therefore it can be used in citrus culture. Indeed, under some circumstances and when reinforced with the correct proportions of the proper chemicals, it stands pre-eminent.

"We have given considerable force to the word **available** because in both ammoniates and phosphatic goods the 'plant food' is so likely to be useless to the plant. When there is an abundance of unavailable plant food in even the poorest soils, **why add more?** The value in applied fertilizer is in its **quick results.** If we have to wait until the next year or the next generation to get returns for the money invested this year we are losing the use of our money, for there is only the plant food we have paid for and the longer it stays in the soil the longer our money is locked up. Some people have expatiated upon the effects shown in after years. A certain amount of plant food will produce only certain

results and the longer it takes for it to produce these results, the more time there is for wastes through drainage, etc. A grower should build up the **texture** of his soil by proper tillage and the addition of humus, but Nature has forestalled him in furnishing unavailable plant foods.

"All our potashes are water soluble and in the same form whether from organic sources, ashes, or from the different potash salts—nitrate, sulphates, muriate or kainit. They differ only as to their surroundings. The organic source used is pulverized tobacco stems and the one drawback is the extreme high cost. This precludes its general use. The potash in ashes also costs so high that ashes are invariably bought because of other qualities and not for their potash content. We have already taken up nitrate of potash under the nitrates, and dealt with sulphate of potash under our talk about acids. We would mention, however, that the low grade sulphate of potash contains a large percentage of sulphate of magnesia and is liked by the citrus grower because this magnesia acts readily as a base and aids in sweetening the land. Muriate of potash is the richest of the potash salts, but because of its chlorine content cannot be used on certain crops. It is especially undesirable for citrus trees and tobacco. Kainit has even more chlorine, part of which is in combination with sodium, making about one-third of kainit our ordinary salt. This is quite effective in vegetable raising for driving away insects and some fungous troubles, but for many crops would need to be applied at least a month before planting or it would 'burn' the plants.

"Thus we have much to think about when trying to supply food to vegetation—just what sources—just what proportion each of the different forms of ammonia used should make of the whole ammonia content, that there be no lack, no waste—just how much phosphoric acid and potash to put with this ammonia to give **exact** balance to this particular crop. It is a long, long

lesson and one that must be worked out in the field. But when it comes to mixing these ingredients, how many times does the lack of chemical knowledge cause great loss? I know, personally, one prominent gardener who mixes ashes with his fertilizer and chuckles as he smells the escaping ammonia, because the mixture is **so strong.** It has often seemed to me that one of the wisest sayings I ever heard in regard to home mixing of fertilizer was: 'The man who knows enough to mix his fertilizer, generally knows enough **not to.**' "

A careful study of the above quotation (see Chapter V.) will give one a very clear idea of the action of the different materials from which fertilizer formulas are made. Every grower should thoroughly understand these points that he may select formulas suited to his purpose. He cannot, though, reasonably hope to be able to construct a formula off-hand superior to those which have been developed through years of grove work shared by several experienced growers throughout the State. **Ideal** formulas have all been created in this way. It is a mistaken idea for a grower to hold that all fertilizer men figure out some combination of chemicals on paper, really knowing nothing of the practical end. Nearly all the leading workers in our staff have owned groves for years and have had all the ups and downs of a grove-maker's life, just the same as other growers, and hold their present positions because they are **successful.** In their travels through the State they have had a chance to gather from the experiences of many others. We feel that they have had rather exceptional advantages and have benefited by them. However, we by no means limit ourselves to home talent. We gather information from every possible source and are constantly working in co-operation with many leading growers. Some of our formulas are due entirely to our friends, while many have reached perfection through their assistance.

In fact, while we give analysis full consideration and ever

seek to have our formulas supply all of each plant food the tree can use to advantage, and at the same time to give no excess to unbalance the proportions, causing at least waste of money, if not actual damage to the tree, we realize that **source** of plant food is fully as important as analysis. Nothing but **high-grade** materials go into our citrus fertilizers—no kainit, muriate of potash, or fish scrap—but even among the high-grade sources there is a great difference in effects and each has its place depending on the kind of soil and the result desired. When a formula meets these demands we feel it deserves the name **Ideal** and place it on our regular list.

In the list of **Ideal** formulas you will find something to suit your conditions, with the price based on the actual market value of its ingredients. There is no charge for the **knowledge** necessary to turn out such a perfect product. If you are in doubt as to which best suits your needs, we are glad to help you in regard to that.

W. & T.'s Special Mixture No. 1

is undoubtedly the best all around growing formula ever put upon the market. It does good work in all kinds of land and for all vegetation. Many of the finest groves in the State have been brought to bearing on this formula and receive liberal applications of it every spring. It is especially valuable in bringing out neglected groves, or creating new heads from old stock. We have made this mixture for twelve years and every one of these years it has brought us new friends by the good work it has done.

Seminole Tree Grower.

This is purely chemical—a happy medium between a growing formula and a fruit and vine manure. It is especially fitted to produce strong, healthy growth either on young trees or in spring-time on bearing groves. In young groves we particularly

recommend it for summer application. Note the high grade sources and the well balanced proportions.

Peruvian Orange Tree Grower.

This is the highest grade growing formula on the market both as to sources and amount of plant food it carries. It is based on a large content of Peruvian guano and reinforced by the choicest materials. Is of equal value for young trees and for spring application to bearing groves and the summer application on grapefruit and tangerines. As one of many examples of its field work see page 27 in our booklet entitled **"Ideal Results from Ideal Fertilizers."**

W. & T.'s Special Orange Tree Grower.

A formula made from Peruvian guano and the choicest of fertilizer materials with an analysis to suit those desiring less ammonia than in our Peruvian Orange Tree Grower and a far smaller potash content. Sources and mechanical condition fully guaranteed.

Ideal Fruit and Vine Manure

is strictly chemical and from high grade sources. It has many staunch supporters who have used it year after year and say that it gives more good quality for the money than anything sold in the State.

W. & T.'s Special Fruit and Vine Manure

is adapted to the general conditions and has been used for years by the greater number of successful growers throughout the State who want a higher analysis than that given by **Ideal Fruit and Vine Manure.** It is purely chemical, derives its ammonia from the slow acting sulphate of ammonia and carries a high percentage of same for a fruit and vine formula which makes it very effective in producing the results desired at this season, especially as its content of phosphoric acid and potash from the

highest grade sources is in correct proportion to give to the fruit all required qualities and mature the wood perfectly, absolutely preventing any die-back conditions appearing and often correcting such troubles when not too far advanced.

W. & T.'s High Grade Fruit and Vine

is another formula made from chemical sources exclusively and is used particularly on low hammock lands and for the purpose of hastening the maturity of the fruit. We made this mixture several years for one of our valued customers before we became sufficiently convinced of its value to put it upon the open market, but the work it has done in his grove during all this time is enough to convince the most skeptical. His fruit is of the highest grade and invariably well ripened up and ready for shipment several weeks before that of his neighbors.

Peruvian Fruit and Vine Manure.

This formula is especially suited to light sandy soils and meets the requirements of those who desire a strictly **natural** fertilizer. It is based upon pure Peruvian guano and ground bone and reinforced with choicest materials to make a perfectly balanced fertilizer. It is one that can be depended upon, not only for its effect upon trees and fruit but it will help to build up the land.

W. & T.'s Fruit and Vine Manure.

A fruit and vine mixture with exceedingly low ammonia content. Made from Peruvian guano, nitrate of soda, sulphate of ammonia, nitrate of potash and sulphate of potash. Sources and mechanical condition fully guaranteed.

Seminole Fruit and Vine Manure

is for hammock and very rich pine lands, carrying a low content of ammonia and deriving part of same from organic sources. For some conditions this has been found to give wonderfully good results.

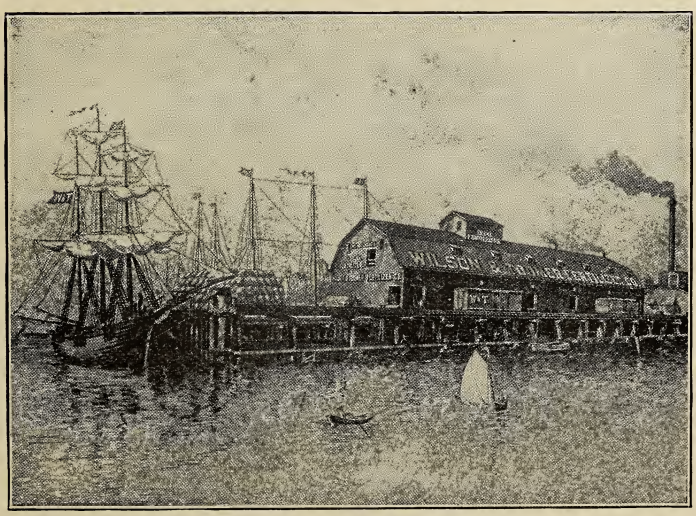
Ideal Blood, Bone and Potash

is made as its name shows from dried blood, bone and potash. Is rather slow acting and has been found very satisfactory on some lands.

Bone and Potash.

This is also for rich lands. As its name implies it is made entirely from ground bone and sulphate of potash. It is the right mixture to use where a slow acting formula is desired and is one that will fill the need of phosphoric acid and potash content.

Full descriptions and prices of the above formulas will be found in our booklet entitled Ideal Fertilizers. Sent free on request.



Our factory previous to 1905.

CHAPTER VII.

Fertilizer Values

Fertilizer has three distinct values—the practical value determined by field results, the State valuation determined by its analysis reckoned at the price per unit fixed by the State Chemist, and the market value which depends upon the market price of the ingredients used.

The practical value is by far the most important. It often takes years, though, to settle upon the true worth of a formula. In some seasons conditions are such that good results can be obtained from almost any kind of a mixture, or again fertilizer may give luxuriant growth but induce diseased conditions or perhaps even make a good plant but cause unproductivity or a poor grade of fruit.

In a citrus grove in particular the good or ill effects of fertilizer are often quite slow in developing. It is this point that makes an old formula much to be desired. When one sees a healthy and **prolific** grove that has used a certain line of formulas several years he has good proof that those formulas are of **practical** value. It is just such proof of the superiority of **Ideal** brands that we can show in all parts of the State. There positively is no other brand of fertilizer that can show so many **profitable** groves that have used its formulas steadily for several years, as can the **Ideal. Ideal** not only induces growth and general health but it tends to great fruitfulness. Many groves now bearing heavy crops of fancy fruit were apparently in good condition but bore so little as to be unprofitable until given **Ideal Fertilizers** according to **Ideal** methods. Note we say according to **Ideal** methods. We do not claim the word **"Ideal"** does this work. One might use **Ideal** brands so unadvisedly as not to obtain the desired results. Each formula is created to fill certain needs, and to give the best results must be used wisely.

In our various pamphlets we deal extensively with this subject, but are always glad to take it up even more fully through personal correspondence.

The State valuation is a quick way to compare the worth of the plant food offered in different formulas. It can not be counted as a **true** value because the prices set are for the three essentials at seaports and make no distinctions in regard to sources. The phosphoric acid derived from bone black is worth fifty per cent. more on the market than that derived from acid phosphate, yet it is accounted in State valuations as worth just the same. Ammonia and potash also vary in cost, though not to so great an extent. Neither are the handling of the materials, storage, office work and other legitimate expenses in running any kind of a business taken into consideration. For comparison, though, this makes no difference, for each manufacturer has practically the same conditions to face. The prices settled upon by the State are:

$3.30 per unit of Ammonia.
1.00 per unit of Available Phosphoric Acid.
.20 per unit of Insoluble Phosphoric Acid.
1.10 per unit of Potash.

A "unit" of plant food is twenty pounds or 1% of a ton. Thus, a formula carrying 4% of ammonia has four **units** of ammonia and lacks $3.30 of being worth as much as one carrying 5% of ammonia and the same content of available phosphoric acid and potash. But suppose this last formula has 1% more potash than the first. The potash is worth $1.10, so the difference in value of the two formulas would be $2.20. We have known many simply to add the units of plant food in each formula with no thought of the fact that one per cent. of ammonia is worth three times as much as a per cent. of potash, and more than three times as much as a per cent. of available phosphoric acid. In

comparing formulas in this way, the sources should be the same, or a mental reservation should be made in favor of the one using the highest priced materials. In this way one can quickly see where he is getting the most for his money.

We should mention another point to which this valuation by units is sure to lead. Perhaps the formula runs 4% ammonia, 6% available phosphoric acid and 8% potash. One soon realizes he is getting 360 pounds of plant food in a ton of fertilizer and many times immediately concludes the manufacturer is using 1,640 pounds of "filler" on which he has to pay freight, etc., and that he had better buy the materials and "know just what he is getting." Well, what does he get when he buys materials? In nitrate of soda he gets 17 pounds of plant food to each hundred pounds he buys. In sulphate of ammonia he gets 25 pounds in every hundred; in boneblack and acid phosphate, 16 pounds and in the sulphates of potash, 26 pounds and 49 pounds. Thus even when he buys materials, a large percentage is not plant food. This has to be for it would not be practical to separate the pure plant food from these combinations or to handle or use it after it was separated. The use of filler is not at all desired by the fertilizer manufacturer, for all fillers are an expense for which he gets no credit. His fertilizer is valued for the amount of plant food it contains and the materials carrying this plant food furnish practically all the ton of fertilizer except in formulas of very low analysis.

The market value will show if the price charged is excessive for the material used. Fertilizer materials are quoted at practically the same figures by all dealers, yet Ideal brands are the only ones not priced several dollars in excess of the amount for which these materials could be bought, mixed and bagged. Of course, in buying the materials in this way, the grower misses the exact proportions that give great value to a formula when several kinds of plant food are used. He would be sure of getting

the same mixture only when there were just three ingredients and then he would have to allow for excess of analysis the same as does the manufacturer, **but we do not charge** for the proportioning of these ingredients. It has been said we could not put up certain formulas from the materials claimed to be used for the money we ask for them. Our one reply is to ask that whoever doubts our ability to do so figure a little on the matter and see for himself. One never will find our prices too low to be consistent with furnishing the materials we claim to use, and our guarantee on sources and mechanical condition is as strong as on analysis. There are strictly legitimate reasons why we can give **good value** for the money. We have had long experience in the fertilizer markets in all parts of the world and have ample capital to buy materials in large quantities and at the most favorable times. Two of the leading railroads have laid their tracks to our factory and ocean steamships can unload at our wharf, so we secure the lowest freight rates possible and delivery is made and shipments taken at our door. Our factory is equipped throughout with labor-saving devices, therefore our fertilizer is handled at minimum cost. Our trade is so immense that the office expenses are much less per ton than is possible in a smaller business. Our every condition is favorable for economy and we give our customers the benefit. While we make the **best**, we can and do sell the **cheapest**.

CHAPTER VIII.

Fertilizing

The following directions for fertilizing are the result of over thirty years' careful study and practical experience. We have taken into consideration the laws that govern the growth of citrus trees, the development of the fruit from the blossom to maturity, the analysis of the wood and fruit and the conditions of our soil and climate; and the good results the Ideal method of fertilization has given for years in all parts of the State speak most emphatically of its merit.

Spring Fertilizing

Our method advocating three applications of fertilizer a year is followed by a greater number of the successful growers, but there are many who are tempted to skip either the summer or the fall application. Some are inclined to feel that after the crop is on the trees it is sure to be matured and fail to realize the loss to them in the small sized fruit and the limited growth made during the summer the tree is left to its own resources. Others appreciate these points, but feel the trees do not need the fall application because they see no growth or development in any way to show benefit from it. That the trees are more vigorous and respond more fully to the spring application after having received fall fertilizer is only too often accredited to other circumstances. But whatever may be the attitude towards other applications, spring fertilizing is acknowledged by all to be essential. At this season there is an unexplainable current of life that pulsates throughout the whole animal and vegetable world. "Spring's impulse" it is often called, and who can deny its influence? The one trouble about its effect on an orange grove is that the grower awakes to the fact that "spring has come" at the time the buds are bursting and new leaves forming,

The above grapefruit, shown by courtesy of Florida Photographic Concern, was raised by Mr. F. Charles Gifford at Vero on Indian River. Mr. Gifford follows Ideal methods absolutely in the management of his grove and his trees always are in perfect condition and loaded down with the choicest of fruit.

or perhaps even not until the bloom begins to show. He then responds to the call of his trees, but is at least two weeks too late to give them the greatest help. Their first and strongest impulse is passed and though they will act on the new supply of material, second efforts are never so forcible as are the first. A tree is Nature's factory and like all other factories, must limit its output to the raw material on hand. The plant food was not ready when needed, therefore, we have lost part of the growth the tree would have made; yet our fertilizer costs us just as much money as it would have done if purchased at the proper time. It does not pay to be guided by one's moods. The successful man looks ahead and provides for the conditions he knows are going to exist.

Besides this loss of growth there is another serious loss from late spring fertilizing.

During the dormant stage many insects deposit their eggs upon the old leaves. When a strong, rapid growth takes place and the new leaves are well rounded out, the old leaves are discarded and fall to the ground, taking with them the millions of undeveloped eggs that in a short time would have hatched and spread over the foliage and fruit, thus necessitating spraying. By liberally feeding their trees at the proper time many growers have succeeded in entirely discarding the spray pump and that means a vast saving in time and expense.

Generally speaking, our spring opens from the 10th to the 20th of February and to have the plant food ready for the new growth it should be applied about two weeks before that time, so the roots can have it assimilated, and at this season, the fertilizer should be either plowed in or worked in with a cut-away harrow except on the low marl hammocks.

We have four formulas that we offer for this spring application, each perfect in its way but suited to the different conditions found in different localities.

W. & T.'s Special Mixture No. 1.

Seminole Tree Grower.

Peruvian Orange Tree Grower.

W. & T.'s Special Orange Tree Grower.

These fertilizers are made from the choicest materials and those most suitable for this time of year. They are easily soluble, for this is the time when we look for our worst droughts that do so much injury to the young fruit.

We believe in plowing in the spring application on the pine land and high dry hammocks, because it turns the fertilizer down to the moist earth and gives a mulching of loose soil above the roots so that they do not dry out so much when the severe droughts come. Then, with frequent harrowing until the rainy season sets in, the moisture in the soil will be conserved and the young fruit will develop properly.

If you are in doubt as to which formula suits your needs, write us fully and we shall be pleased to advise you. We have given this matter close study for over thirty years and are glad to give you the benefit of our experience.

After deciding upon the formula, the question arises: How much fertilizer does the tree need at this time? We will suppose you have given your grove a fall application and the trees are full of vigor, but, if you have not, that much is lost and cannot now be regained. Trees that will bear five boxes of fruit need about twenty pounds for this spring application, while if ten boxes may be expected an additional ten pounds should be applied. If this seems too much to you, just consider the tree must live first. After that need is supplied all the fertilizer that is assimilated is transformed into growth and fruit. Now, what better investment can you make than to turn a few cents' worth of fertilizer into a few dollars' worth of fruit, and besides, have the bearing surface of your tree increased for the next year's crop? But bear in mind.

this spring fertilizing is simply giving the trees and fruit a good start. If more food is not supplied in the summer much of the crop will be lost, for the tree has to have food to develop the fruit properly and also to make the summer growth.

Summer Fertilizing

Summer fertilizing has a many-sided significance and is not given nearly so much attention as it deserves. The tree has all the fruit its vitality has enabled it to hold and is eager to carry this fruit on to maturity. If insufficient material is at hand to provide for all the demands of this season, Nature will put her best effort into the developing of the fruit and give scant heed to its size and the growth of new wood. The grower, however, can not afford to overlook the importance of these items.

While over-sized fruit is not at all to be desired, the number of fruit required for two boxes of the 252 size would pack nearly three boxes of the popular 176's and would also bring more per box. It is natural for the fruit to grow through the summer season and if the material is there for the tree to work upon, the fruit will increase in size throughout the warm weather. On this one point the summer application more than pays for itself, but we must not think of size alone as making fruit desirable. Though size is important, quality is far more to be sought after. There are few vegetations that show such marked influence from source of plant food as does the citrus family. It has taken years to learn the exact sources and proportions of these sources to use in order to gain the very best results.

The perfect orange must be heavy with luscious juice, not too tart, nor must it be insipid. There must be little "rag" while the skin of strictly fancy fruit is of a beautiful reddish color, smooth and velvety to the touch and though thin, so tough as to enable the fruit to reach distant markets in perfect condition. Proper culture and fertilization will produce such fruit, and the

grower reaps great reward for careful attention to these matters.

Quality has ever been given too little prominence in citrus culture, quantity having been the grower's watchword; but the time has come when quality must be given first place. Fortunately quantity does not need to be sacrificed to secure quality, for a tree in condition to produce perfect fruit will naturally bear freely. **Ideal** brands are most effective in bringing about these conditions and make yearly by far the greater share of the fruit that brings the highest market prices. It is well though for the grower to remember that however fine the crop may be as a whole, not every orange can be fancy and that it is impossible to give too much care to strict grading. Just a few inferior oranges in a box will drag the entire box down to their level.

It is the nature of the citrus family to make another growth of branch just when the fruit is draining so heavily upon the tree's resources, and it is upon this growth that a great deal of the next year's bearing wood is produced. Thus a lack of nourishment at this time limits the area of the bearing wood and in consequence, the next crop is smaller than it might be.

As a specimen of what citrus trees will do we would call your attention to the grand old giants of Clearwater shown in our booklet entitled **Ideal Results From Ideal Fertilizers.** Our trees should outlive us, becoming more valuable each year, and they will do so if given the proper care. It is when Nature is restricted and made to feel that her efforts are of no avail that she gives up the struggle and disease and death find their way into our groves.

For a time after the spring growth the orange tree is practically dormant, the little twigs rounding out and the young fruit slowly enlarging, but by the middle of May it begins to prepare for the summer growth of branch and the rapid development of the fruit, and the wise grower will have ample food at hand that he may reap full reward from Nature's efforts in this direction.

We are fully convinced that about the 20th of May is the proper time to make this summer application. Too many growers wait until the latter part of June or even July when the growth is out, thus continuing the flow of sap until late in the fall and thereby make their fruit coarse and also retard the ripening several weeks.

The trees need their food before they start to make their growth so that the ammonia will be used to increase this growth and also because it is just at this stage of the fruit's development that the ammonia will give it size without affecting the fineness of grain which is so desirable a quality. When our perfectly balanced formulas are applied at the right time the ammonia is taken up in this way early in the summer and all through August and the fall months the fruit develops slowly and the branches gradually harden to sustain their increased burden.

The formulas we offer for this application are varied to fit different conditions of soil and different requirements of the growers.

W. & T.'s Special Fruit and Vine Manure.

Ideal Fruit and Vine Manure.

W. & T.'s High Grade Fruit and Vine.

Peruvian Fruit and Vine Manure.

W. & T.'s Fruit and Vine Manure.

Seminole Fruit and Vine Manure.

Ideal Blood, Bone and Potash.

Bone and Potash.

The quantity to be used for summer application necessarily depends upon the size of the tree and the crop it is carrying. A tree carrying five boxes of fruit will need about fifteen pounds of fertilizer while one carrying ten boxes requires about twenty-

five pounds. Remember, a tree is but a factory and can produce growth and fruit only as it is provided with materials to do with, and it is poor economy to restrict its output of dollars by depriving it of a few cents worth of food.

Fall Fertilizing

It would seem that just at the time when the year's work of the orange tree was completed and the grower was exchanging its fruits for money he would feel like doing something nice by such a faithful servant, but cold facts reveal that of the three needed applications of fertilizer during each year it is the fall application that is the most begrudged and the most often neglected. The two excuses most commonly given are that the owner is too busy packing fruit and that the tree does not need any more food until spring because it will make no more growth. If we could but bring all the tree owners to feel that trees are alive and in many ways closely akin to animal life, it would be a great work. Trees need their nourishment just as much as man or beast. We are particular to have our three meals a day whether we work or not, and who ever neglects to feed his work horse because he is "too busy" or because the horse is not going to work all night?

The owner has generally taken a vacation over summer, either at home or away, the horse has had little to do all through the hot months, but the tree has worked every day making or maturing new growth and developing a crop of fine fruit. All its resources have been drained, and when the fruit is fully matured it is exhausted just the same as man is after a long, hard day's work, and Nature provides it a resting period which can well be compared to our night. We feel the need of our evening meal and know that though we are seemingly at rest through the night, Nature is busy repairing the wear and tear of the day and getting us ready for another day's labors. Her work could not be so well

done did we take no nourishment at night and we in no way feel that having an evening meal removes our need of breakfast. This is exactly the view we should take of fall fertilizing. Nature needs that plant food to replenish the tree's forces that it may act vigorously in response to the call of spring and use the fertilizer given it at that time for growth and bloom rather than a greater part of it merely to keep the tree alive. Many a man who would be scandalized at the thought of keeping a bony horse keeps his grove in a similar state of semi-starvation. He feeds it just enough to keep it alive, or perhaps he is more liberal and keeps the trees in fairly good condition, but stops just short of the point where they could set and **hold** a remunerative crop. It is not natural for a tree to drop its young fruit. Nature is very conservative and is not at all inclined to waste her energies starting fruit to be thrown away. A tree will hold all the fruit its vitality will allow and it is upon the **fall fertilizing** that the vitality depends to a great extent.

From the 15th of November to the 15th of December seems to be the right time for this application to give the best results. The following formulas are recommended for use at this season:

Ideal Fruit and Vine Manure.
W. & T.'s Special Fruit and Vine Manure.
Peruvian Fruit and Vine Manure.
W. & T.'s Fruit and Vine Manure.
W. & T.'s High Grade Fruit and Vine.
Seminole Fruit and Vine Manure.
Bone and Potash.

A tree large enough to bear five boxes of fruit will need about fifteen pounds of fertilizer at this application. This fertilizer can be applied according to the method of cultivation employed for the grove. It can be harrowed in if the grove has been plowed, or chopped in with a cut-a-way harrow, or hoed in around the trees and covered with a mulch or simply left on the surface to be carried down by the winter rains. Each

of these different methods have been found successful under some one of the various conditions to be found. This is a great State and it is, to a great extent, the diverse soils and climates it represents that causes the many different opinions as to the proper cultivation of a citrus grove. But though the methods of cultivation vary ever so widely trees in all sections need this fall fertilizer to be gradually taken up and assimilated by the roots during the winter to establish full vigor; then when spring's impulse comes the response will be strong and enduring.

Fertilizing Young Trees

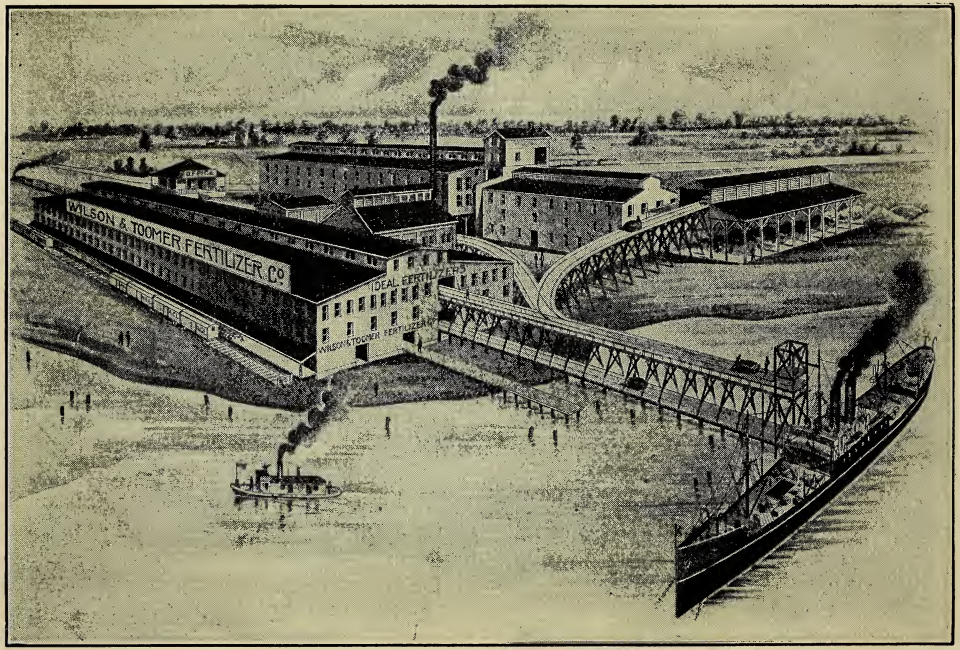
For young trees we recommend the formulas:

W. & T.'s Special Mixture No. 1
Seminole Tree Grower
Peruvian Orange Tree Grower

for spring and summer applications in amounts depending upon the size and conditions of the trees.

For fall application our **Seminole Tree Grower** is used in the lower East Coast section, but in the center of the State and on the West Coast it is customary to apply a little **Bone and Potash** or only potash, or often nothing at all.

Young trees should be kept well worked except over summer. During this season disturbing the soil is likely to create acid conditions. Extra heavy mulching should be used, for the grass or cover crop **must not** be allowed to choke the trees. Make the circle of mulching considerably farther out than the outermost branches, for one should always strive to create a large root surface. In working young trees, while the greatest care should be taken not to tear the roots, one should disturb the ground at the outer edge of the circle to a depth of three or four inches, if possible, to cause the roots to strike down deep and thus be less likely to dry out than when near the surface. Remember **Ideal** brands are long past the experimental stage. They have produced many of the finest bearing groves in the State.



The above represents our factory at Idealia Point, as eastern suburb of Jacksonville. Any vessel that can cross the St. John's bar can land at our dock, and the tracks of two leading railroads are laid to our doors. Our main building is 230x400 feet, and is thoroughly equipped to give you IDEAL service.

CHAPTER IX.

Picking and Packing

Our aim in this book has been to tell people what would be of real service to them. We are now to one of the most important phases of citrus growing but we can give very few directions beyond telling what should receive attention. This part has to be learned by actual demonstration in the field and packing house and can be perfected only by considerable experience except in cases where one has a natural gift for judging fruit.

A grower about whom the neighbors jeer because he throws away box after box of "perfectly good fruit" is one who is doing good packing. It is the packer who culls closely that makes the money. Citrus fruits are easily damaged. A clipper cut, finger nail abrasion, thorn prick, or drop of six inches will ruin their carrying qualities. The picker should be provided with ladder, clippers and picking receptacle. The ladder should be placed with great care. The picker who threshes his ladder about to secure a firm resting place bruises or thorn pricks more fruit than his day's work is worth. There are many clippers on the market now that do good work, being shaped so they will cut a short stem and yet so that it is almost impossible to harm the fruit while doing so. A short stem is absolutely necessary because of the damage done other fruit by the end of the long stem. The requirements for a good receptacle are that the fruit finds an easy resting place within and is protected from outside pressures; also that it be shaped to empty into the field box without jarring its contents. There are many different contrivances, each having its firm supporters. Many of the growers are having the pickers wear white gloves, and all insist upon short finger nails. The field boxes should be small enough so one man can lift them and set them down without jarring. The ends should be enough higher than the sides as to make it impossible

for the fruit to come against the bottom of the box packed above it. A **spring** wagon should always be used in hauling fruit. The custom of washing fruit is becoming more and more firmly established. While an absolutely perfect and unblemished fruit cannot be made to look any better than it does when picked from the tree, by far the greater part of the crop is vastly improved by the washing; besides, a fungicide in the wash water will do much towards retarding decay. There should be drying racks that the fruit may have good circulation of air around it and dry readily. It is especially important that no decayed fruit be left in the house, for the infection spreads rapidly. Wherever a bit of decay is found, the wood should be washed thoroughly with a strong fungicide.

Each grove should send out at least three, if not four, different brands. To have a brand of value the fruit shipped under it must always be uniform. There are many points necessary to make a **strictly fancy** fruit. Some growers seem to think "fancy fruit" means the bulk of their crops, but the buyer does not look at it in that way. He is looking for **defects** not good points, and if he finds them he either buys at reduced prices or not at all. The successful packer must take this viewpoint: "Every doubtful orange is a cull," and all will be well.

All grades of fruit fit to be shipped at all are worthy of neat packing, but the style should compare with the grade. Fancy paper is out of place on low grade fruit. A neat trademark denoting its brand might be used, but plain paper of good quality is better. The brand will be shown on the box. For strictly fancy fruit we believe in attractive little "stickers" on the fruit itself and as pretty a design on the wrapping paper as can be devised. Lace paper folded over an attractive picture showing either the trade mark alone or a view of the grove with the trade mark in one corner to greet the opener of the box will cost but a few cents and increase the selling price from fifty

cents to a dollar. All these points count, but **quality of fruit** is of first importance, **neatness** of pack is next, after which the **fancy** pack can be taken into consideration. For the convenience of the packer we have had cuts made from Bulletin No. 63 of the Florida Experiment Station showing measurements and ways of packing for the different sizes of oranges and grapefruit.

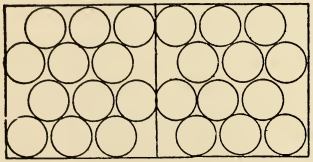
Before letting the fruit leave his control, the shipper should be as well satisfied of the honesty and ability of the person about to handle it as he would be before he loaned as much money as the fruit is worth. It is quite safe to say that the greater number of growers in the State could get 25% if not even 100% more net profit than they are getting if they would pay proper attention to packing and shipping.

(By our Special Artist.)

A view in the grove of Mr. C. C. Pierce, Brownville, in packing season—an IDEAL customer.

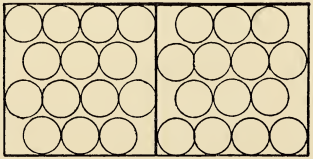
SWEET ORANGES

No. and Size 96;
Dia. 3½ in.; Layers 4.



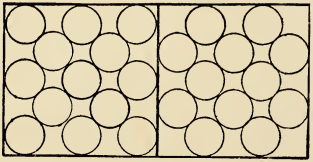
Layers 1 and 3—12; Layers 2 and 4—12.

No. and Size 112;
Dia. 3¼ in.; Layers 4.



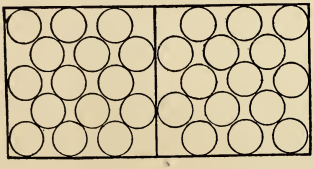
Layers 1 and 3—14; Layers 2 and 4—14.

No. and Size 126;
Dia. 3 1-8 in; Layers 5.



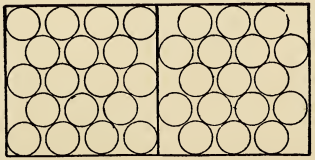
Layers 1, 3 and 5—13; Layers 2 and 4—12.

No. and Size 150;
Dia. 3 1-16 in.; Layers 5.



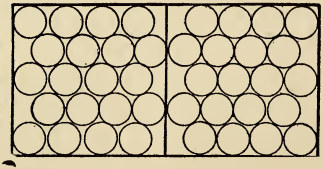
Layers 1, 3 and 5—15; Layers 2 and 4—15.

No. and Size 176;
Dia. 2 15-16 in; Layers 5.



Layers 1, 3 and 5—18; Layers 2 and 4—17.

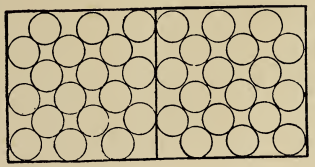
No. and Size 200;
Dia. 2 13-16 in.; Layers 5.



Layers 1, 3 and 5—20; Layers 2 and 4—20.

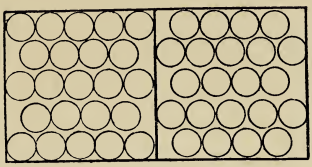
SWEET ORANGES

No. and Size 216;
Dia. 2 11-16 in.; Layers 6.



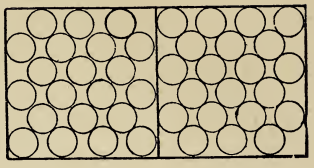
Layers 1, 3 and 5—18; Layers 2, 4 and 6—18.

No. and Size 226;
Dia. 2 9-16 in.; Layers 5.



Layers 1, 3 and 5—23; Layers 2 and 4—22.

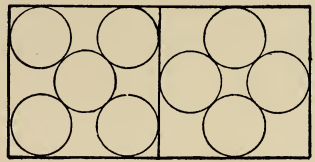
No. and Size 252;
Dia. 2 7-16 in.; Layers 6.



Layers 1, 3 and 5—21; Layers 2, 4 and 6—21.

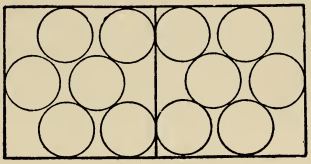
POMELOS

No. and Size 28;
Dia. 5¼ in.; Layers 3.



Layers 1 and 3—5; Layer 2—4.

No. and Size 36;
Dia. 5 in.; Layers 3.



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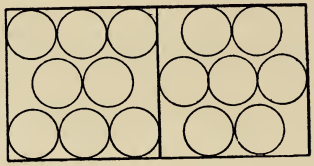
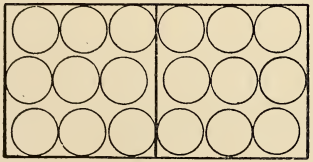
No. and Size 46;
Dia. 4¾ in.; Layers 3.



Layers 1 and 3—8; Layer 2—7.

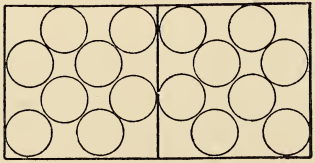
POMELOS

No. and Size 54;
Dia. 4½ in.; Layers 3.



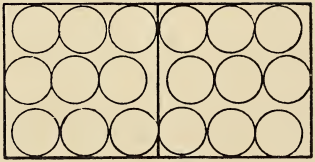
Layers 1 and 3—9; Layer 2—9.

No. and Size 64;
Dia. 4¼ in.; Layers 4.



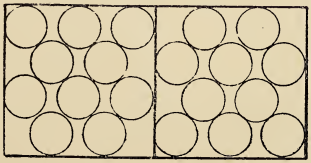
Layers 1 and 3—8. Layers 2 and 4—8.

No. and Size 72;
Dia. 4⅛ in.; Layers 4.



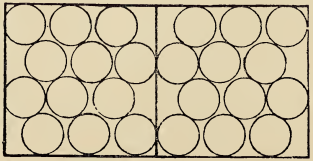
Layers 1 and 3—9; Layers 2 and 4—9.

No. and Size 80;
Dia. 4 in.; Layers 4.



Layers 1 and 3—10; Layers 2 and 4—10.

No. and Size 96;
Dia. 3⅝ in.; Layers 4.



Layers 1 and 3—12; Layers 2 and 4—12.

Preventives and Remedies
FOR
Insects and Diseases
IN THE
CITRUS GROVE

In taking up this part of our subject we are between two very different viewpoints, and it is quite difficult, if not an impossibility, to please either, not to mention the idea of pleasing both.

The new-comer or prospective settler will look aghast at the number of troubles that may come to him and almost hesitate at embarking in an enterprise "so hazardous"—never considering that we are pointing out a way to prevent or correct nearly every trouble, and that these troubles do not number nearly so many as could be counted against almost any other enterprise. The many flourishing groves in the State are as vulnerable as his grove will be, yet they not only exist but are profitable investments, through being given the same careful oversight needed to guide any business to success.

On the other hand, the experienced grower will feel that it is a waste of paper to devote so much space to things that "anyone knows"—forgetting that it took him some years and more or less sad experience to learn the points that seem so simple now. He had to learn by experience, for the citrus industry of

Florida was then so young that the needs of the tree were unknown to all, and each problem had to be worked out. The "end is not yet." We all can learn more on this subject, year after year, but the industry is now based on certain well-proven facts, and our object in going over this ground is to give the newcomer the chance to profit by our experience. Accompanying these well-known points, though, will be found much that will be of value to the average grower of long experience, for our articles have been most carefully prepared.

Anthracnose.

The fungus causing anthracnose makes itself manifest to citrus growers in many unpleasant ways. Several years ago, after most painstaking microscopic work, Prof. P. H. Rolfs demonstrated the effects of this fungus and rendered a great service to all interested in citrus culture. The term anthracnose has now come to mean the effect of the withertip fungus on the fruit. All kinds of citrus fruit suffer from its attacks while extremely young, often in the bloom even; then there seems to be a period of immunity lasting until the season for ripening. When the bloom is attacked the lesions are brick red to brown in color. With a lens the pustules can be seen on petals and all parts. Much fruit the size of buckshot will drop, leaving calyx on tree, but this is not a sure sign of anthracnose. One may expect this trouble with both bloom and fruit if his tree is affected with withertip, but must find the brick-red fungus before he is absolutely sure, because there are several other causes for bloom and fruit dropping. Also it is possible for anthracnose to appear at this time when it has not been noticed previously that withertip was present. The greater part of the matured fruit becomes diseased while still on the tree, but if the fungus spores are present they will develop even after shipment. The least abrasion helps the spores to become established, but their tiny

"roots" can enter a perfect fruit and in any part of it. Sometimes the area of infection is small, and again it will cover nearly the whole surface. The diseased spot may remain about the same size for days or it may spread rapidly. The first sign of infection is an irregular brownish stain. As the disease develops the spots become gray or even lighter, but when the spore-bearing parts form they give the affected area a dirty black color, either all over or in the older spots shading from these colors through those denoting the different stages until the healthy rind is reached. The diseased spots are generally sunken except where the spores are forming. They frequently cause slight elevations. Anthracnose confines itself to the rind for awhile, but eventually attacks the pulp. Fruit generally drops as soon as the disease has become well established, but may hang on the tree for some time.

Conditions Favorable for Development.—Anything to weaken the general health of the tree, whether lack of fertilizer, improper fertilizer, unfavorable climatic conditions, insects, other diseases, or bad physiological surroundings.

Preventives.—Removing any of the above conditions that are present, pruning out diseased branches, cleaning away all infected fruit as soon as discovered, and spraying thoroughly with ammoniacal copper carbonate, letting the spray fall from **above** as much as possible. This fungicide should also be used in the wash water to prevent development en route to market.

When anthracnose attacks the bloom it is advisable to spray thoroughly with weak Bordeaux mixture, directing the spray into the bloom as much as possible. The Bordeaux will kill a good many blooms, but not as many as the anthracnose will without it; and the same with young fruit. The spray will cause much of that to fall. Tender growth is also likely to be hurt, but the fungus **must be killed** or it will do far more damage than will be done by spraying. (See Withertip.)

Blight.

This disease is also known as wilt and leaf curl. It attacks all kinds of citrus trees, but the grapefruit is more resistant than the different oranges. It is a disease of bearing trees and seemingly selects the best trees in the groves. It appears to be infectious because trees surrounding a diseased tree generally develop the disease; but as to the cause of the trouble no one has succeeded in gaining the least clue. The first symptom is a wilting of the foliage and is generally seen in early spring At first this is slight but becomes so pronounced as to be continuous through the wet season. The foliage begins to drop, and finally the affected branches lose nearly all their leaves. Any new leaves forming are very small and of a dingy green color. Though the branches may be practically leafless, they will bloom profusely and for a longer period than the normal blooming season, but rarely set any fruit. Generally the tree lingers on for several years, throwing up new sprouts to die back and more and more of its branches becoming affected until scarcely more than a stump is left, but sometimes a tree will die outright within a few weeks. Experience has proven it to be a great mistake to leave a blighted tree in the grove. As soon as one is **sure** the disease is blight the tree should be dug up and burned and a new one set in its place. Do not drag it through the grove for fear of infecting other trees. This may sound rather hopeless to the new-comer, but blight claims so few victims any grower can well pay the tax, while there is many a grove in the State that never has had even one case of the disease. The one point is to **watch** and act decisively when blight appears.

Decay in Transit.

The following facts, demonstrated by Prof. Lloyd S. Tenny, Pomologist of the United States Department of Agriculture, Washington, D. C., may emphasize the need of careful packing. Needless to say the result of his researches will apply equally to grapefruit or other citrus products:

"During a cool, dry period many Florida oranges reach the market in good condition, but when the weather is warm and moist, cars of fruit arrive showing sometimes as much as 30 per cent or more of decay. A conservative estimate of the total loss from decay in Florida oranges would be $500,000 annually. There is an even greater injury to the reputation of Florida oranges because of the large amount of decay that develops after the fruit reaches the hands of the wholesale dealer or the retailer.

"The common decay in oranges is caused by the growth of a minute form of plant life within the tissue of the fruit. * * * These fungi are spread by spores which do not seem to have the power of entering an orange having a normal uninjured skin. The first requisite for decay, therefore, is a bruised or broken skin. * * * Like most other forms of plant life, these fungi grow best in a warm, moist atmosphere. If the weather is cold or very dry, even injured fruit on which the spores are present may not decay."

The most common injuries to the skin of the orange are caused by clipper cuts, scratches made by pulling fruit through the branches of the trees, splinters from the field crates, twigs and gravel in the bottom of the boxes or long stems on other oranges and cuts from the finger nails of the pickers or packers. Prof. Tenny found fruit from eight pickers averaged 6.1% clipper cut, 9.6% other injuries, and 16.8% long stems. If each long stem hurt only one other orange the total of injured fruit would then be 32.5%, but one could not hope for such good luck. The

quality of their work does not necessarily depend upon the rapidity of the pickers' movements—some of the fastest pickers were proven the most careful and vice versa.

In the packing house it was proven that a far greater loss resulted when the fruit was sized by machinery than when handled by hand. This is not at all an argument for hand work, but for improved machinery. Hoppers and steep runways are especially disastrous. About one-fifth of the oranges subject to drops, but otherwise handled with the utmost care, showed decay, so one may realize the damage done by emptying a field box into a hopper. Carrying belts should be used where a quantity of fruit is handled, otherwise change the fruit from picking receptacle to field box and from field box to rack by hand. The advice of one most successful packer is, "Always handle an orange as though it were an egg." Citrus growers surely should give this matter the greatest attention, for it is an injustice to themselves and the whole industry to allow such a drain from their net returns.

Die-Back.

There is no more common trouble in Florida groves than die-back, and yet, despite long acquaintance with the havoc it makes among our trees and the most careful scientific research, the nature of the disease is not known. It is quite generally believed to be the result of malnutrition, but as to the exact form of "indigestion" no definite conclusions have been reached. We have, though, learned to combat the disease quite successfully.

The foliage of a tree about to suffer with die-back is generally a very dark green—often the tree has made a rank growth and to the uninitiated appears to be doing wonderfully well. The ends of this luxuriant growth turn yellowish and finally reddish-brown. The stains are likely to spread over all the new growth after this discoloration appears and the twigs soon die back sev-

eral inches. The disease is accompanied with wax-like exudations through the bark of both old and young growth and secretions of a gum in pockets in the wood at or near the buds. Another characteristic is multiple buds. Trees having die-back generally produce very little bloom. This is in marked contrast with those suffering with blight, for blighting trees bloom profusely. The young fruit has not the rich, dark green color of the normal immature fruit, but is a sickly pale green. Much fruit falls while it is yet small, but a greater number reach a size of from 1 to 1½ inches in diameter, when they turn a pale yellow that has no resemblance to the healthy orange color. From this stage on the fruit falls rapidly, only a small percentage reaching full size. Generally they split before dropping. The split usually shows first at the apex of the orange, then opens across the fruit, exposing the segments. The fruit also show tiny brown exudations in different parts of the rind. This is called "ammoniated," or "fungused" fruit, but neither term is correct. Die-back, as far as is known, is caused by neither ammonia nor fungus though it is quite true some of the fertilizer "ammoniates" induce its appearance. The brown markings of die-back fruit resemble anthracnose, but may be distinguished by the fact that anthracnose markings are depressed, while die-back spots never are. Die-back fruit is further to be distinguished by the gum deposits in the inner angles of the sections at the center of the fruit. The small portion of fruit from a die-back tree that does mature ripens earlier than its healthy relations, but is so coarse, thick-skinned and disfigured that it seldom finds a market.

Conditions Favoring Die-back.—Poorly drained soil is sure to bring about die-back conditions, but that poor drainage is not the sole cause is amply proven by equally bad cases of the disease being found on pine land, shell land and low hammock. Ill-advised cultivation is another "forerunner" of an attack of die-back, while organic ammoniates—stable manure, dried blood,

cotton-seed meal, etc.—are especially harmful. A very unbalanced fertilizer, exceedingly high in ammonia, might induce die-back conditions by creating growth entirely lacking other food elements to mature it; but this would be only when a greatly excessive amount was put on either accidentally or for experiment. It could never come about by using the formulas of commerce, that are made from the proper sources. Indeed in our experience we have often found that die-back trees were suffering from the lack of ammonia.

Remedies.—Make sure of having proper drainage. Do not feel satisfied because your trees are on elevated land that **appears** to be well drained. Often there is a clay basin that holds the water. If such is the case it must be cut through. If acid conditions are found, apply either a ton of ashes, a ton of slaked lime or two or three tons of finely powdered limestone rock per acre. The ashes can be left to be washed down by the rains, but the others must be worked in; therefore we prefer the ashes for it is far better not to work die-back trees. It is always better to let the native growth take possession of all except a heavily mulched circle around the trees. If one **knows** too much ammonia has been applied, the grass should be removed when mowed and the ammonia omitted from the fall application of fertilizer, after which well balanced formulas made from purely chemical sources should be used. For spring application use **Seminole Tree Grower;** for summer, **W. & T.'s Special Fruit and Vine Manure,** and for fall use the **Ideal Fruit and Vine Manure.** If the die-back has developed from other causes, correct the causes and use the formulas recommended above from the first. They can be spread on the surface of the ground, covered with mulch and left to find their way into the soil. There will be no loss unless lime or ashes is applied with them. The Florida Experiment Station has made some experiments with bluestone and so far does not feel justified in recommending its use for

die-back, but we have great faith in its efficacy. It is, of course, necessary to remove the disturbing influences that are causing the trouble, and very often that alone is sufficient to bring about a cure, but many other times from a quarter to a full pound of powdered bluestone scattered upon the ground well away from the trunk, or a bit of bluestone from the size of a grain of wheat to a split pea inserted under the bark near the base will stimulate the tree and bring about a cure in a much shorter time and sometimes when we fear all other means would fail. As die-back is a physical condition it must not be expected to show improvement immediately. The cure will take time and must come about gradually, and while this is going on **do not starve your trees** and thus deprive them of the vitality they need so much to help them throw off the disease.

Dropping of Bloom.

Much bloom-dropping is natural to a tree, for Nature makes ample provision for reproduction and many of the blooms will never be properly pollinated. An early spring drought following a moist winter, late cold spells chilling the bloom, heavy rains, and high winds all cause loss of bloom and are practically beyond the control of the average grower. Irrigation would overcome the first, artificial heat the second, and sufficient wind-break the fourth. The most serious of all losses, though, is that caused by the withertip fungus. The first sign of this is generally the falling of unopened buds. If we find on these buds brick-red lesions or patches we can be very sure withertip is at work, but can decide the question without doubt by a strong lens which will show the pustules of the fungus. This trouble can be relieved to a great extent by the use of Bordeaux mixture. (See Anthracnose.)

Dropping of Fruit.

As explained under our chapter on Fertilizing, the greater part of the loss from spring dropping can be prevented by fertilizing judiciously. The right fertilizer even makes a great difference in the tree's ability to hold fruit through the spring drouth; still, there is a limit to its powers and every possible effort should be used to conserve the moisture at this season. The trees will use it in growing and developing the fruit if it is not all needed to prevent dropping.

Fall dropping is due to disease or physical conditions. We have taken it up under the different diseases that cause it. If heavy rains fall near ripening season they are bound to cause dropping, and this we cannot prevent. The loss from high winds in the fall is considerable even when we have a fairly good windbreak, and there always will be a small loss from birds and insects puncturing the skin, and thereby making way for decay, but by fertilizing and cultivating wisely and keeping the grove free from disease the grower can keep his loss from dropping down to a small per cent.

Foot-Rot.

This disease attacks the sweet orange and rough lemon stock chiefly, and, while quite prevalent in the days of sweet seedling orange groves, has been reduced to an occasional appearance since the common use of sour stock, which is almost immune.

The first symptom of foot-rot is an appearance of gum on the trunk near the base. The gum will stand out in drops over one or several areas and increase as the disease develops. The bark will be discolored and have cavities filled with gum. The inner bark decays, giving out a strong, disagreeable odor. The gum generally appears in the spring or early autumn and in about three months the disease will have progressed so as to throw off the bark of the diseased area. As it has also destroyed the

life-carrying cambium layer there is no chance for new bark to form.

Foot-rot can be distinguished from gummosis by its position at the base of the tree and by its peculiar odor.

Cause.—Improper drainage, too close planting, excessive and continuous use of organic fertilizers, excessive cultivation, continued excessive irrigation and deep planting influence the disease, but that it is not strictly physiological is shown by its being contagious.

Preventives.—Plant sour stock and avoid the conditions named above as being favorable for the development of the disease. When foot-rot is in any part of the grove great care should be taken not to spread it. Infected trees should not receive any part of their cultivation continuously with the rest of the grove, for the plow or harrow is likely to carry contagion as well as the hoe or knife. Any tool used around a diseased tree should be washed in equal parts of crude carbolic acid and water immediately so there can be no possibility of its infecting other trees.

Treatment.—Sunlight and air seem to be the essential remedies. The dirt should be removed from around the roots for two or three feet from the trunk and farther if necessary to reach all diseased portions. Six months is none too long to leave the tree this way, though, of course, one must not endanger the life of his tree through exposure to cold. All diseased portions of bark, trunk or roots should be cut away, leaving smooth surface. Cut well back into healthy tissue—the line of demarcation shows plainly. Paint these surfaces with any antiseptic. Carbolineum avenarius is our preference, but carbolic acid diluted one-half, soda-sulphur solution, and even whitewash have served the purpose. The main object is to remove the infection and let Nature heal the wounds. Where trees are set too close they often have to be thinned out so as to allow sunlight to reach the ground before this trouble is overcome.

Frenching.

This is a term used for a yellowing between the veins of the leaf. Frenching is not a disease but is merely a symptom of bad physiological conditions, and, therefore, may either accompany a disease or be the first warning to the grower that unhealthful conditions surround his heretofore flourishing tree. These conditions may be insufficient food or food from the wrong sources; or a condition of the soil that is uncongenial to proper development, either because of acidity or lack of proper aeration. Liberal application of well-balanced chemical fertilizers will supply the proper nutrition and an application of ashes or slaked lime worked in as thoroughly as possible without disturbing the roots of the tree will not only correct acidity, but will improve the texture of the soil. Thorough drainage is essential to keep the soil sweet and mulching is a help toward keeping it loose and open to free circulation of air.

Fumigation.

There is no question but that the surest and quickest way to rid a tree of all insect enemies is by fumigation, but the way for a community to make it a practical proposition is for all growers to co-operate so that **every** grove is given strict attention. Otherwise, though a grower cleans his trees thoroughly, they will become reinfested from his neighbor's grove during the next swarming period. When fumigation is carried on properly and on a large scale, the expense is slight for the results given; but since, to a single grower the expense of a fumigation outfit is almost prohibitive and the results likely to be unsatisfactory unless his grove is isolated, we will not give space to the subject in this book. Any information desired will be furnished gladly through correspondence.

Fungi.

This article is especially intended to answer some of the questions sent to us in regard to fungi and spraying.

There are two distinct classes of fungi. One preys upon vegetation. These we call "noxious" fungi, for the different species are detrimental to our interests. The fungi belonging to the other class prey upon insects or their larvae, so to us they are "friendly" fungi. There is no possibility of the friendly fungi attacking trees for they cannot live on live vegetation.

We advocate the use of fungi for scales and whitefly because that is the natural way to combat these troubles. The diseases caused by noxious fungi which must be treated with Bordeaux mixture can be avoided as they are able to gain a foothold only when the trees are weakened by other causes. The grower should look ahead, and, with proper fertilization and cultivation, guard against such conditions. This is easy to put on paper, but being growers we know just how hard it is always to make ourselves give the groves proper attention. They look so well we forget there is need for constant battle and unconsciously take things easy for awhile, much to our subsequent regret. To err is human, and when these situations confront us they must be overcome with the best means at hand; but this fact should in no way lower our ideal. We should ever strive to raise our fruit by natural, not drastic, methods, for working with Nature will, all in all, prove easier and more economical. We fully believe that with right management one needs never to use anything besides the sulphur and lime dust spray for rust mite and whale oil soap solution for whitefly and scales during the dry seasons, and when, because of unknown climatic conditions the sulphur and lime dust acts as a fungicide against the friendly fungi. There are some growers who do not use even these simple remedies, but they are exceptionally competent and attentive and only a few can reach that degree of efficiency

There are several friendly fungi which are either natives of or have become so well acclimated to Florida that there is very little trouble in introducing them. It takes about three weeks for them to become so well established as to be visible to the unaided eye and often longer when dry weather conditions exist. We must remember, though, that fungi can do a vast amount of work before they become so plentiful as to be noticed. The organisms are so minute that illustrations have to be enlarged from 75 to 200 times to give us any idea of their appearance, yet, just one spore (seed) from one of these tiny plants is sufficient to kill the larvae upon which it settles.

These fungi can be obtained at slight cost from Messrs. C. A. Boone, Orlando, Frank H. Davis, Apopka, and others. The black, red-headed and white-headed fungi are used for scale insects, and the red, brown and yellow for the whitefly.

Scale fungi are generally sold on pieces of bark two to four inches long and are introduced by tying the bark in a position favorable for the dew or rain to carry the spores to the scales below. For whitefly, the fungi are generally sold on leaves which may be pinned in contact with infested foliage, but this method has been almost entirely displaced by spraying, and we believe scale fungi will soon be applied in the same way.

About eight leaves well covered with ripe red, yellow or brown fungus are generally used to a gallon of water, but from two to four times as many should be used when the fungus is pink colored or weathered. They should be soaked at least ten minutes and may stand several hours without injury; stir well and strain through a fine wire strainer. Do not put the fungi in any receptacle that has been used for Bordeaux mixture or other fungicides, and if a pump with brass or copper parts is used, do not allow the spray to stand longer than necessary to do the work.

For scale, the trunk and infested limbs should be treated, while for whitefly, the nozzle should be directed to the underside

of the leaves. To do this the operator needs to stand close and spray upwards and against the opposite side of the tree. A powerful pump gives far better results than a weak one because of the spray being forced through the foliage, thereby reaching more of the leaves. Though fungi may be introduced at any time, the work is usually done from April to October because the results are so much more satisfactory than in a colder, drier season.

Gummosis.

The true cause of this disease is not known but it seems to be infectious, though some individual trees have proven themselves immune.

The first symptom is the exudation of thin watery gum from cracks in the bark. Later the gum is thicker and collects in masses. The bark cracks more and more. Gum may continually ooze out or it may stop at intervals. Where the disease is not too severe new bark will form under the old, but often the wood decays and the limb or even the entire tree dies.

When the bark has become badly broken up if the gum ceases to exude, the rains will wash away the old gum and leave the affected area looking very much like scaly bark, but gummosis confines itself to the trunk and larger limbs while scaly bark has the characteristic "nail head rust" spots and covers even the tiniest twigs, so the two diseases may easily be distinguished. Neither is there danger of confounding gummosis with foot-rot though both exude gum, for the gum in gummosis never oozes out near the base and it is nearly free from the fetid odor, a sure accompaniment of foot-rot.

Remedies.—Though not nearly as serious as scaly bark, gummosis should have prompt and persistent attention. It is far easier to eradicate when it first appears than after it has become well established. The best treatment known at present is to peel off all the diseased bark and smoothly chisel out any decayed

wood, then paint with full strength carbolineum avenarius. New diseased areas will appear from time to time and these must have careful attention. A grove can be entirely freed from gummosis but "eternal vigilance" and prompt action is the price.

Mealy Bug.

So far the mealy bug has been only a slight annoyance to a few growers, but in some sections it is appearing in greater numbers. Were they to become thoroughly established it would be a serious matter, for sooty mold is likely to follow any insect exuding honey dew; besides, such sucking insects impair the tree's vitality when present to any extent. The mealy bug is about a sixth of an inch long, is dull brownish yellow in color, has a white powdered appearance and is inclined to gather in clusters. The eggs are laid in a cottony mass attached to the end of the abdomen. The larvae settle along the ribs and veins on the under side of the leaves, in the forks of young twigs and where fruit clusters come together.

Remedies.—Ants help increase these insects by spreading them over greater surface and caring for them for the sake of gathering the honey dew; thus the first step is to destroy all ant nests with bisulphide of carbon or some preferred agent. Upon the insects themselves nothing has proven more effective than kerosene emulsion applied with great force. Whale oil soap at the rate of a pound in three gallons of water will kill the young mealy bugs. Sometimes when small limbs are badly infested it is better to prune them out and burn them; when the bugs settle upon the fruit they should be wiped off with a cloth wet in a solution of whale oil soap.

Melanose.

Melanose is always associated with a weakened condition of the tree. It affects the fruit, leaves and twigs. When very severe it greatly reduces the vigor of the tree, retards the growth of young trees, even permanently stunting them if allowed to continue, and hurts the selling qualities of the fruit by its unsightly markings. The true cause of melanose is not known. The markings of melanose are light brown to black rounded or conical elevations from mere points to one-sixteenth inch in diameter which may be separate or run together, forming irregular raised areas or lines in curves or rings. Melanose starts on young tissues. The lower limbs are likely to be more severely attacked than the upper part of the tree. The first sign is the appearance of sunken points scarcely discernible with the unaided eye. Under a lens these points show a brownish waxlike substance which raises as the disease develops until as described above. The tissue around these spots may become yellow. On the twigs, though, they are often so close together as to completely cover the surface. These melanose spots occur on both sides of the leaves but are more pronounced on the mid-ribs. Sometimes the leaves are drawn out of shape and become pale or yellowish green. The markings on the fruit are not so raised as those on the twigs and leaves, and a cursory glance might confound it with die-back fruit, but the markings on the latter are not raised and do not run in curves or circles, and no gum occurs in the angles of the sections of melanosed fruit. The melanose spots are wax-like and shrink toward the center, often raising edges of the mass and giving a scale-like appearance.

Remedy.—To conquer melanose it is necessary to spray with either Bordeaux mixture or ammoniacal copper carbonate. This spraying must be done early in the season to be effective, for when the fruit rind is once spotted nothing can remove the dis-

figurement. Swingle and Webber advise two sprayings, "the first about two weeks after the flowers have fallen and the second about a month later." Bordeaux mixture and ammoniacal copper carbonate are both fungicides and will kill the friendly fungi that keep the scale in check, so should be followed by whale oil soap. They also will kill any fungi that has been introduced to prey upon the whitefly, therefore, it is quite likely another introduction will be necessary when the rainy season opens. (See Fungi.)

Mites.

"Red Spider" and Other Mites.

These mites are different when viewed under a microscope but as they have the same effect on the trees and yield to the same treatment, we feel that they can be classed together. They are sucking insects and do great damage by causing young fruit to drop and by defoliating the trees. They flourish during the dry spring months and disappear when the rainy season opens. If one has an irrigation system he can overcome this trouble by drenching the trees, but otherwise he must use the sulphur preparations as advised under Rust Mite.

Rust Mite.

The rust mite is a tiny little fellow that can not be seen with the unaided eye unless collected in large numbers when the whole army has the appearance of a slight coating of dust. But though of such small size, its work is by no means insignificant. It is probably safe to say that it makes a difference in price of about fifty cents per box on half the citrus fruit raised in the State. Rust mites feed upon the essential oil of the rind. The air that enters the punctures made by them turns the oil dark colored and thus causes a "rusty" appearance. As the mites prefer shade to direct sunlight, they do most of their work on the lower side of the fruit. Fruit thus attacked is likely to be undersized.

Strange as it may seem, russet oranges are sweeter and keep longer than the brighter and more attractive fruit, but since they do not bring as much money the investor needs to exterminate the rust mite as soon as it appears. This is generally about the middle of May, but sometimes fruit is damaged during the last of April. The trouble usually continues for about two months but often hangs on much later. Indeed, it is not at all strange for a grower to find that his fruit which was nice and bright when first matured has grown rusty during the few weeks he has held it on the trees.

Preventives.—All spider mites are sensitive to sulphur in any form. The most popular way to combat the rust mite is by using a dust spray of equal parts of sulphur and slaked lime every two weeks through the rust mite season. The one drawback to this is the need of the application being made when the foliage is wet. Since sulphur in this form is far less likely to harm fungi, there is seldom need of spraying for scale after the application. Many growers use the soda-sulphur spray at the rate of one-half gallon stock solution to forty gallons of water. Lime-sulphur solution may also be used but care must be taken not to burn the foliage

Scales.

Although there are many different species of scales, it is not absolutely necessary for the practical grower to distinguish them, as all yield to about the same treatment. Scales are sucking insects, and in extracting the juices of a tree, cause irritation either by the beak itself or by the injection of a poison. This is insignificant for the single individual, but scales multiply rapidly and soon their number will greatly weaken a tree. Their presence also tends to smother vegetation as they pack so closely that they interfere with normal respiration. This is especially true of those that exude honey dew, for the honey dew itself helps to close the pores and besides it is likely to become the host of sooty mold which will further restrict proper functioning in the areas it covers.

There has been such a marked increase in scale infestation during the past two or three years that many have thought it was due in some way to the whitefly. It is very evident that this is not so, for this scale trouble has been felt outside of the whitefly regions, while some groves badly infested with whitefly have shown no increase in scale. Dry weather is undoubtedly the primary cause of scale increase. It retards the growth of the fungi that keep the scale in check and also renders the trees less able to stand the drain put upon them. When the grove also has to support a horde of whitefly it is no wonder that the trees nearly succumb. It is an established fact that insects as well as diseases are generally quick to injure weakened vegetation, so that the grower can make his first and most effective stand against such troubles by keeping his trees vigorous.

Under Fungi will be found necessary information in regard to introducing Nature's remedy, but as we can not always wait for that and since there are many who prefer to spray, we will consider the application of contact insecticides.

The time and manner of spraying is fully as important as the solution to be used. Scales produce from two to four broods per season. The time when these broods may be expected depends much upon climatic conditions, so there can be no satisfactory spraying calendar prepared. A grower should be able to recognize the eggs and larvae and spray when by the number of larvae it would seem that the brood has hatched. Since it is not possible to see the newly hatched larvae with the unaided eye, a hand lens should be used, when they will show as small, yellowish or whitish insects, sometimes crawling, sometimes at rest. Soon they attach themselves to the tree, on either the bark, leaves or fruit, and become covered with a waxy secretion, at which stage they show as tiny white dots. It is during these two stages (the crawling larvae and the newly settled larvae) that spraying during warm weather should be done, for the eggs and adult scales are not so easily destroyed. Some scales, like the San Jose Scale for instance, do not lay eggs, but give birth to living young which appear irregularly and not in broods.

There is generally a brood of young scale in early spring. One pound of whale oil soap to six gallons of water is effective against scale larvae; but any spray is likely to cause newly set fruit to drop, so the spraying should be either postponed until the fruit is the size of a hickory nut or directed against only the trunk and limbs where the scales are gathered. As the season is more advanced whale oil soap may be used as strong as 18 pounds to 50 gallons of water. Kerosene emulsion, kerosene and water, and tobacco decoction are also effective when correctly applied. In using kerosene great care must be taken not to burn the foliage. It must be in right proportion and used on sunny days. The above remedies are not fungicides and therefore will not interfere with fungi becoming established. The sulphur solutions are strong fungicides and if one feels he must use them against scale it is better to confine the spraying to as small an

area as possible so as to leave some fungi unharmed. Soda-sulphur spray is used for crawling and newly set scale at the rate of one gallon stock solution to 49 gallons of water. This is also effective against purple mite and new larvae of the whitefly. Lime-sulphur solution is used for San Jose scale in peach orchards to a great extent because it can be applied during dormant seasons, but it is likely to burn the foliage of a citrus tree when strong enough to kill adult scale. This solution is good for very young scale and for six-spotted mite and rust mite. After using either of these sulphur solutions it is sometimes necessary to make applications of whale oil soap to keep the scale from multiplying until the scale fungi become reestablished, so one may as well use fungi and the whale oil soap from the first. We advise the use of fungicides in a citrus grove only as a means to conquer fungous diseases.

Scaly Bark, or Nail Head Rust.

This disease is at present confined to a very small part of the orange growing section. It is caused by a certain fungus and has been present in the State fully forty years. However, it is only recently that it has developed into a real menace to groves. The scaly bark fungus seems to be very slow acting until brought into association with the withertip fungus, but the work of the two together has created a problem that as yet has not been solved satisfactorily.

We quote in full Prof. Fawcett's description of the first stages of scaly bark attack, and trust all will note same carefully, because, by prompt and decisive action, the disease can be eradicated before any real damage is done: "The spots first make their appearance on branches six to nine months old or older. On branches younger than this spots rarely occur. The first indication of a diseased spot on a branch is a slightly raised band or ring one-sixth to one-quarter inch in diameter. In many cases

this band is composed of small dots or pustules that appear to have broken out from under the green bark. A small point also appears near the center of the spot. In other cases, the beginning of a spot is marked simply by a lemon-colored area, which at its first appearance is nearly the size of the fully matured spot. The bark on the affected area gradually becomes rust-colored, hard and brittle, and in the course of eight or ten months presents the appearance described above. [Begins to crack and forms flakes or scales.] On new spots only the bark appears to be affected. A new bark is formed under the old as the latter cracks and flakes off."

Scaly bark will spread over the whole tree from the trunk to the tiniest twigs if allowed to do so, the diseased areas running into each other until finally limbs are girdled and die. Not only this but the withertip fungus attacks these diseased places and kills branch after branch with its poisonous action and also hastens the work of scaly bark. Where scaly bark has become thoroughly established there are three ways to deal with it: (1) Applications of Bordeaux mixture after pruning out thoroughly which diminishes the percentage of affected fruit, but unless followed by sprays of whale oil soap, this treatment allows scale to increase to such an extent as to damage the trees about as much as the scaly bark. (2) Heading Back.—This should be done in December or January, before the trees start to grow. Cut out the top, leaving only the trunk and stubs of the larger branches and paint these thoroughly with full strength carbolineum. By the end of summer a vigorous top will have made which is free from the disease but unless the whole grove is treated this way the tree is likely to become infected again. (3) Top Working.—Really the most feasible way known at the present time is to top work the grove in the scaly bark section, grafting in varieties immune to the disease. This, though drastic, wins the battle at once, while the other methods are a continual and expensive fight

against the ravages of the enemy. Grapefruit, tangerines and mandarins all appear to resist scaly bark. That the loss of income may not be too great it is well to treat alternate rows through the grove and when these trees come to bearing, top-graft the others.

There is a disease called "gummosis" that in its more advanced stages greatly resembles scaly bark, but there are some strong distinguishing features, so close observation will prevent the two being confounded. These points are taken up under gummosis, which is far more common and less serious than scaly bark.

Sooty Mold.

Sooty mold is a black fungus that lives upon the honey dew excreted by insects. It will soon follow the appearance in a grove of the whitefly, mealy bug, soft scales, wax scales, or cottony cushion scales. Since the honey dew falls upon the leaves and fruit below, sooty mold becomes better established upon the upper surfaces. To many who have not studied plant life, its presence means only the added trouble and expense of washing the fruit before shipping, but this is the least important result of its presence.

Though it does not enter the tree at all, it fits so closely to it, especially to the leaves that the pores are clogged and respiration is more or less prevented in the areas covered. Respiration is the only means vegetation has to obtain its carbon. Since carbon is a large per cent of all solid vegetable matter, all the functions of the tree are limited by the supply of carbon, and any interference with respiration is a serious restriction. Not only this, but the chlorophyll can not act on the carbon present except when exposed to the light and in proportion to the directness of the sun's rays. Thus the shade produced by the presence of sooty mold further weakens the proper functions of the covered

portions. Green fruit carries on this assimilation of carbon the same as leaves and green twigs. When the immature fruit is coated with sooty mold it generally does not attain full size and is even more lacking in sweetness and flavor because of its inability to manufacture sugar without proper supply of carbon and sunlight; hence the effects of sooty mold are far beyond remedy by washing.

Preventives.—Sooty mold can be killed by any fungicide, but our friendly fungi will be killed at the same time, and by the time the dead sooty mold has "weathered" off, new will have established itself if the insects are still present, so the real point of attack should be the insects.

When they are exterminated the sooty mold must die from lack of nourishment. A spray of whale oil soap is more or less effective in loosening this sooty mold. After it is loosened the winds and rains soon remove a large percentage of it, so such an application may sometimes be of great advantage.

Stem End Rot.

This disease was not recognized as being of any importance until the fall of 1909. When it became known that it was causing great loss in some sections the season was too far advanced to allow extended experiments. It is a fungous trouble and therefore will yield to ammoniacal copper carbonate, but it is too soon yet to have learned just how and when this should be applied to be the most effective and still interfere as little as possible with the friendly fungi.

Whitefly.

The whitefly is a tiny insect, but it has created a great problem. Theoretically, the trouble can be overcome by correct fumigation, by introducing fungi during the period of summer rains, and by spraying judiciously with whale oil soap during spring, fall and winter.

Practically, while the whitefly has been **kept out** of many sections by some system of quarantine, we do not know of any infested area where the whitefly has been exterminated. Some groves, which became infested before the danger was realized or proper treatment known, are owned by men as capable as can be found in the State, who have a surplus of capital and energy, and yet they acknowledge defeat. Their most strenuous efforts keep the fly down only enough to allow crops to be grown, and each year brings a renewal of the battle. This experience is a great lesson—**Keep the whitefly out.** Clear away its food plants: China and umbrella trees, persimmon, olive, green ash, jessamine and privet, which it prefers next to citrus, honeysuckle, fig, oleander, pear, etc., which are its second choice; in all twenty-seven different kinds. If one learns of whitefly appearing in any part of his section, he should act promptly. It is just as much to his interest to exterminate it as though he owned the trees, and it is far more **profitable** to fight whitefly in a neighbor's grove than at home.

There are three species of the whitefly. The "woolly whitefly" is scarcely known and the "cloudy winged" species is less dangerous. It is the "white winged" species that has made itself so famous (or infamous) among citrus growers. In summer the life cycle (from egg to adult) is from forty to fifty days. In winter the time varies according to weather. There are seven stages in the whitefly's development: egg, four different stages of larva, pupa and adult. It is most difficult to kill the egg, pupa

and adult by anything but fumigation, hence it is no time to act when the adults are swarming and making themselves so prominent. They are laying eggs which are so small 20,000 of them have been found on a single leaf. In about two weeks after the swarm has disappeared the larvae will have hatched. The newly hatched larvae are only about one-eightieth of an inch long and are so thin as to seem like flattened white scales. At this time at least 95 per cent of them can be killed with a weak whale oil soap spray, but thorough work must be done to accomplish this result. The spray must reach the insects which are on the under side of the leaves. The result of this depends more upon the workman than upon the mixture used. At the fourth stage the larvae are about one-eighteenth of an inch long. As they increase in size and vigor they are more resistant, but it is quite possible to spray so as to kill nearly all of them up to the pupa stage, and even some of the pupae.

There generally are three well defined broods of whitefly. The first appears in March, April or May; the second is seen in June, July or August, and the third in August, September or October.

Dr. E. W. Berger, of the Florida Experiment Station, has given the whitefly most careful study. Indeed, it is due largely to his work that so much is known of its life and that it can be checked so effectively. He advises spraying with whale oil soap in the spring, and urges doing the work as soon as the young are well out for four reasons: "(1) The whiteflies are in the young larval stages and are easily killed; (2) they are mainly on the new growth and more easily sprayed; (3) the larvae are destroyed before sapping the strength of the new growth, and before much sooty mold has developed; (4) there is little rain to interfere with the spraying." During the summer he recommends introducing fungi, as this is a favorable season for fungi to become established sufficiently to do more or less good throughout the year,

and because he feels that sprays of insecticides will do little good at this time because there are so many eggs and adults that will not be affected, and frequent rains occur which wash off the spray. The red fungus is to be preferred, for it will grow on both the white and cloudy winged species and seems to be more hardy than the others. Brown fungus is rather uncertain to start, and yellow fungus will grow only on the cloudy winged whitefly. The white fringe fungus is very delicate. Unless the fungi are very well established the fall brood of larvae should be sprayed with whale oil soap in October or early November. It is essential to leave as few whiteflies as possible to over-winter, for although they are more or less dormant through cold weather, the first sign of spring finds them hard at work increasing their numbers.

Winter is the proper time for fumigation. See our article "Fumigation" in regard to that treatment. Sprays at this season should be much stronger. Whale oil soap may be used at the rate of one pound to three or four gallons of water. Kerosene emulsion and other contact insecticides are also effective. It is important that the spraying be so thoroughly done that the foliage is drenched.

It is far better for a community to form an association and thus have every grove thoroughly treated. One neglected grove will serve to keep the whole neighborhood fighting. One town in Middle Florida has kept this pest at bay for the past three or four years by work carried on with the fund raised by an assessment of one cent per tree. Several growers have kept the fly to one corner of the grove by frequent and thorough sprayings. The time and money put into such work is most profitable—profitable in even greater proportion than stated in the saying, "An ounce of prevention is worth a pound of cure." We now know the power of the whitefly, and there is no excuse for its being allowed to increase its territory.

Withertip.

We have mentioned in the article on Anthracnose Prof. Rolf's valuable work in recognizing that several diseases in the citrus grove were due to one fungus. This fungus has a long Latin name (Colletotrichum glœosporioides), but is now generally known as the "withertip fungus." It seems to be almost universally present throughout the State and ever ready to do its deadly work where other factors have paved its way by weakening the trees. Its one redeeming feature is that it can not attack healthy vegetation.

Withertip, as its name implies, causes the young growth to die back. It may be distinguished from die-back by the lack of multiple buds and gum pockets, and from blight by the foliage not wilting, but it is very likely to be found in a tree suffering from die-back or blight, for such conditions invite its appearance. Withertip will attack trees of all ages, even seedlings in the nurseries. On budded trees less than a year old it generally confines itself to the leaves but unless the trouble is corrected it will finally extend into the twigs and kill them back. In this way a tree may not increase in size for four or five years, and probably will finally die. On older trees it works in various ways. By killing new growth it prevents much blooming; by infecting the blooms it causes many to fall, and then much of the young fruit that sets is lost before it is the size of a marble. We have discussed this matter under Anthracnose.

Remedies.—Since this is a fungous trouble, it would seem that thorough spraying with Bordeaux mixture would cure it, but, unfortunately, the action of the fungus creates a toxine that is taken up by the sap and is beyond the reach of sprays. This demands the use of the pruning knife. One can see how far the toxine has entered by the gray color of the bark, or by the yellowing of the leaves on the twigs, and must cut well below the

affected wood and close to an elbow. **Leave no stubs** or they surely will become reinfected. Often one will find a line of demarcation between the gray and the natural twig. That is a sign that the tree has established a barrier and the toxine can go no further in that twig, but when withertip is established in any part, the tree will weaken more and more until its usefulness is over. This pruning should be done twice a year when the trees are not growing, probably in January and July. The work must be thorough to be effective—**all** diseased wood should be taken away—the cuts must be smooth and the larger cut surfaces painted with carbolineum. Burn the prunings. Spray thoroughly with Bordeaux mixture to kill any existing spores and give the trees plenty of well-balanced fertilizer and extra good care in every way to make a vigorous growth that will repel the attacks of the fungus.

Yellow Spotting.

This is not the well-known "leaf spot" which is now recognized as the effect of the withertip fungus, though this fungus is often present as in other cases, where by any cause the tree is weakened and greatly aggravates the trouble, nor is it the yellowing caused by die-back, starvation, insects, etc., but a disease distinct in itself. The exact cause is unknown but apparently yellow spotting is due to direct effects of improper culture or fertilization, or to the condition of the soil brought about by such methods. In the grove it has the appearance of being contagious, but scientific efforts to transmit the disease have not been successful, so its attacks on groups of trees may be due wholly to the fact that these trees suffer under the same conditions. Trees under three or four years of age are seldom attacked. Generally the spotting is noticed after a heavy crop of fruit which is good proof that lack of vitality induces its development. It is confined to the leaves and in light attacks does little damage, but since the leaves are the

organs for both breathing and digestion, anything interfering to any extent with their proper functioning is most serious. Yellow spot causes swelling in the spongy tissues of the leaves and the formation of a corky tissue which excludes the air and thus stops all action in diseased areas, but even more serious than the disease itself, is the foothold it gives to the withertip fungus; so it is important to recognize its appearance and take prompt action toward building up the general health of the tree. Prof. B. F. Floyd describes yellow spot as follows:

"There are many variations in the gross appearance of the spots, thus making it difficult to give an exact description of them. These variations are evidently due to the different reactions of the leaf-tissue to the disease stimulus. The typical spots on the leaves are yellowish to golden-colored areas, a fraction of an inch or more in diameter. They usually occur between the main veins and extend through the substance of the leaf. The areas differ in appearance on the upper and under surfaces. On the upper surface the yellowish or golden color is more noticeable; the central portion of the area is often darker in color than the margin. It often presents a shiny, dark-brown appearance. The discolored area is not raised above the surrounding surface of the leaf. The surface of the spot on the lower side of the leaf is often rough and projecting. It usually has a dull, greasy look, and a yellowish-brown or olive-green color. The surface in old spots may become dark colored and melanose-like."